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DETERMINATIONS OF
SOME ANIMALS

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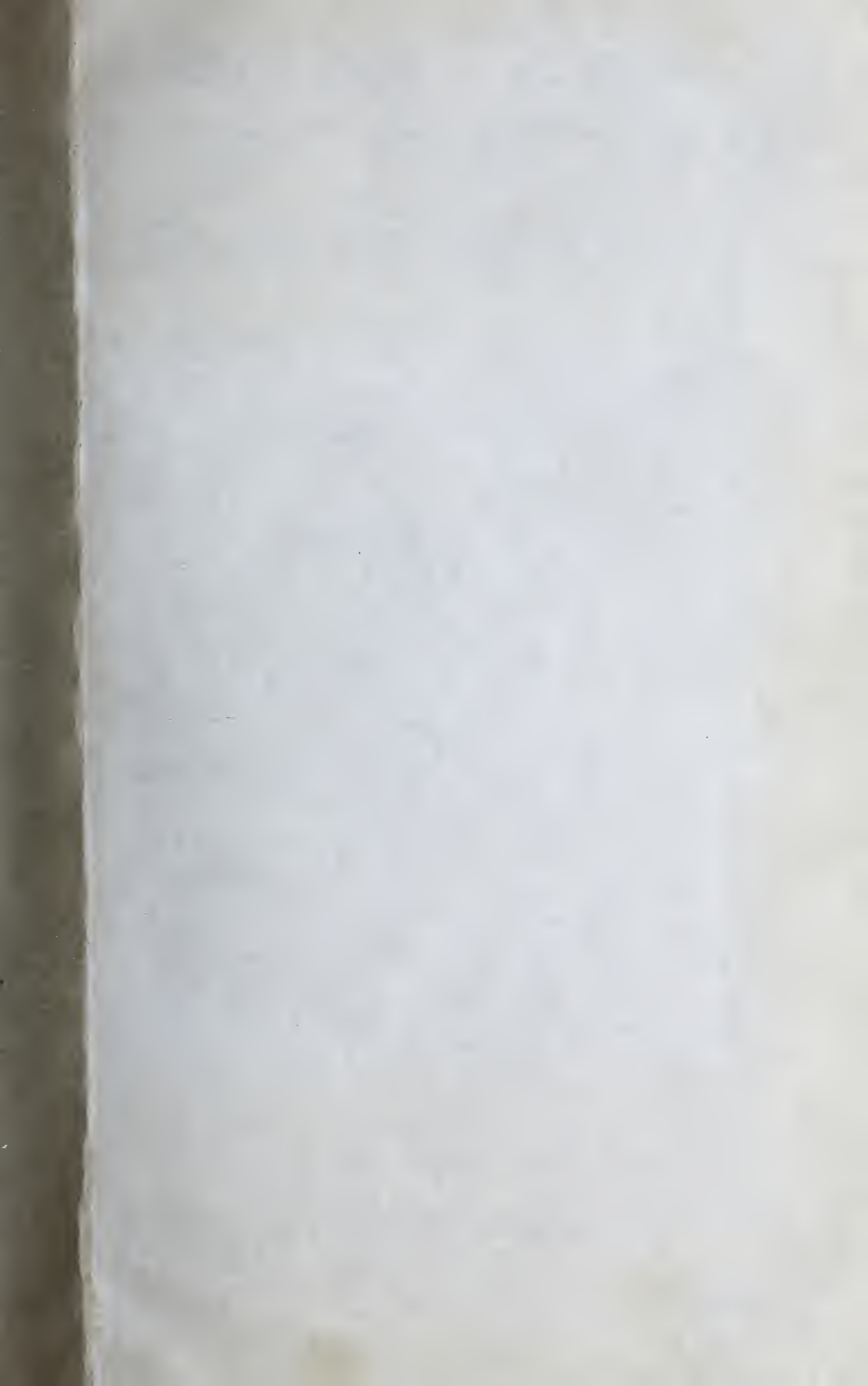
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James S. Grim

COMMON ANIMALS

BY

JAMES S. GRIM



Keystone State Normal School

KUTZTOWN, PENNSYLVANIA

THE DETERMINATIONS
OF
SOME COMMON ANIMALS

BY

J. S. GRIM

1909

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PREFACE

About the first question asked by people in reference to anything unfamiliar is, What is it? What is its name? However interesting an animal may be in itself, the natural curiosity as regards its proper name seems to take precedence over all other questions. It is certainly true that the knowledge of a mere name of any animal means very little in educational values. It is at once conceded that neither the common, nor the scientific or both names, unless vitalized by an intelligent contact with the animal, can substantially enrich the minds of anybody. One man can acquire a vast fund of valuable data about the common toad, for example, calling it simply "the hopper," and thus be in possession of more facts that are really worth while than another who can glibly give its entire scientific classification and nothing more.

It is of interest to know that many children will put themselves to a great inconvenience to ascertain the name of an object and when this information is given a feeling of complete satisfaction seems to be theirs, so much so that a further spontaneous interest is brought almost to a sure stop. Right here is the teacher's opportunity. If there is a natural craving for the name, then in its acquisition a more permanent interest should be awakened, if possible, not by "telling" but by properly "teaching" the proper name.

In order to do this the stuffing process just averred to, either by the teacher or by the pupils themselves, can not be employed. A besetting sin on the part of many a teacher who knows the names of common animals, is to "tell" his students, e. g., that this is a "Cecropia moth," that a female "Promethea moth," etc., possibly giving, too, the order, family, genus and species in one breath. This under certain conditions, may be excellent as far as it goes

(iii)

281051

or as the first step in a lengthy educational process. But, we believe, as a rule, that if the student, after searching in a simple manual, tells the teacher that this must be the "Cecropia moth," because the specimen tallies perfectly with its description, then an affirmative answer from the instructor constitutes the true teaching process in this particular case.

Inasmuch as zoology has only recently been placed in many High School courses, it can hardly be expected that the majority of these teachers are in a position to act with perfect freedom in the presence of a multiplicity of animal forms. This uneasiness on the part of the teacher should be removed. Two points should be kept clearly in view. The first is that it is an intellectual impossibility for any one man to know the specific names of even the majority of animals in its range, even though this were desirable; the other is that the common forms that are more or less conspicuous in size or color—those to which in many cases common names have been added, can, if properly presented, be fixed, as far as their family at least, without much work.

This pamphlet is the outgrowth of a desire on the part of the author to save time and expense on the part of the vast majority of his students who desire to ascertain for themselves the names of certain animals which they have either seen or collected, but do not care to buy expensive books to do so. A laboratory library—a very excellent thing for general reference—does not meet this demand in large classes for four reasons: In the first place the terminology is too difficult in the large systematic works; in the second place over a hundred students cannot very well use together one or even a few books; in the third place the classic manuals that are full enough in the specimens described are usually too full to avoid confusion for the average student; in the last place, let it be assumed that the foregoing reasons are not defensible, the fact is that only one student of every hundred will buy expensive

nature books of this kind in after life, which means that the ninety-nine are more than apt to discontinue their interest in this line of work, not having the proper books for the work.

Some of our good elementary texts in zoology, however, partly meet this demand. Davison's zoology, by the American Book Company, contains a wealth of original illustrations of animals which the inland student will actually see. Many of the forms herein described are pictured in that book. Most of our zoologies, however, are sea-shore text-books with emphasis on the sea. The inland forms are treated rather incidentally. We believe that for us it were better if the inland fauna received the strong emphasis, and the marine forms be treated incidentally, or merely to complete the series.

This pamphlet describes only those animals which our students have collected. We have made a list of these specimens and have listed some as common every year or only on certain years and others as rare. This list should have some ecological value as regards the distribution of certain species. Two thousand eager eyes—several hundred each year—have been looking for butterflies, e. g., and dozens of the dark forms of the tiger swallow-tail have been brought in during different seasons; this we take it shows a slight inaccuracy in Prof. Comstock's "How to Know the Butterflies," which contains the statement that this specimen is found only "from Delaware to Montana and southward." The specimens briefly described herein, perhaps too briefly, are only such as seemed to catch the eye of beginners. It is only too evident that there are others in this range that have not been seen as yet. Indeed, quite a few species caught here have been added to the laboratory collection by Prof. Gruber and by the author, which were apparently never seen by students.

Many of the difficult specimens were submitted to specialists for identification, so that we feel reasonably certain that their determinations are correct.

The number following each common name is the laboratory number of the specimen, and most of the descriptions and measurements were made directly from this identified material. The student, therefore, has the opportunity of verifying the determination of his specimen by referring it to the identified species.

Most of the synopses given here are severely artificial and unnatural. In beginning the subject, we believe, that this is justified by its fruits. A "key" is usually looked upon as a necessary evil or hardship, and it frequently is. The main reason for this lies in the fact that ordinarily authors include too much for the beginner, or make the student rely on obscure characters. In many cases the author was bold enough to be thoroughly original in the construction of these keys, in other cases he simply adapted and radically modified the general keys of others.

A word or so in reference to collecting and preserving specimens should be in place here. Fleishy animals like fish, larvae, frogs, spiders, etc., should be placed in a bottle and preserved in 3 per cent. formalin. This grade of formalin is made by taking 30 parts of water to one part of the formalin which can be bought from any druggist. A little hole should be made in the animal's body to allow the liquid to enter. Killing may be done by placing the animal in a tight box with a small piece of cotton saturated with ether or chloroform, or by putting it—the usual method—in a cyanid jar. If the ether method is used with insects it is only necessary to surround the abdomen with a little cotton saturated with the ether. The cyanid jar is usually made by placing bits of potassium cyanid (a violent poison) in a pint jar or wide-mouthed bottle, and covering these small pieces with Plaster of Paris paste. The lid or cork should be kept off for several hours to allow the paste to harden. We frequently cover the paste, now hard, with a circular piece of blotting paper. Insects are killed in this jar in a minute or so.

Nets for catching butterflies, etc., can be bought for about \$1.00 or they can be made for a few cents. To make one, take a handle several feet long and attach a piece of stiff wire at one end in the form of a barrel hoop, the diameter of which should be a little more than a foot. A bag about two feet long made of mosquito netting, or of cheese cloth for small forms, should then be sewed to this wire.

Animals with broad wings like grasshoppers, butterflies, etc., should have their wings spread before they are allowed to dry and harden. This spreading may be done by placing the specimen on its back on a piece of card board or soft board and running a pin through the body to hold it in place. The fore wings are then pushed forward so as not to overlap the hind wings. Strips of narrow cardboard hold these wings apart if a pin, e. g., a mourning pin, is run through the cardboard placed over the wings. A pin should not pierce the wing as it enters the wood or cardboard upon which the insect rests. After the specimen is spread the pin which was run through the body should be removed.

In about a week the specimen will be stiff. It may be mounted on cotton in a case that costs about 20 cents or between two cleaned photographic negatives, cost about 3 cents. The latter method has the advantage of displaying both sides of the specimen, and several disadvantages. If the negatives are used, the specimen may be placed on a neatly cut bit of cork which is glued to the insect's body and to the glass. The cork need not be used. But care should be taken that there is no smear of glue on the glass. The negatives are usually held apart a little more than the width of the specimen by four pieces of wood-strips placed around the edges, to which the glasses are glued. Passe partout binding should cover up the outside face of the wood and edges of the glass. Related forms should be placed in the same case. If possible the

life history stages of the insects should be together. At all events grasshoppers, moths, dragon-flies, etc., should not be brought together at random in one case.

Forms like field mice should be skinned and the skins treated with a little arsenic. The skins should be filled out with cotton, wires placed through the feet and tail, and the skulls cleaned and saved. The skull should be placed in a vial and both skin and skull labeled.

As before stated collecting and identifying animal forms are only one step in a course of zoology, and very frequently, the killing part at any rate, a step to be taken only when a real intelligent appreciation of the animal cannot otherwise be had, should be omitted. We do not share the maudlin sympathy of those who would go in sackcloth and ashes if they heard of the death of "a dear little grasshopper," nor do we condone any reckless waste of life in any of God's creatures, excepting those economically destructive. The brutal and feelingless instincts awakened in a boy, whose great ambition is to kill something, brutalize the boy more than it pains the creature over which he may gloat.

In order to maintain a permanent interest in the *live* animal its name, as a handle, should be known. What has been written about it in literature can then be read. It has been studied at close range under the most favorable conditions. The interesting habits of that species in its habitat can then be more appreciatively studied, which should mean a greater respect and reverence for biologic laws as illustrated in these lowly forms.

The metric system is used in these pages. A meter, m., is approximately 40 inches; a decimeter, dm., four inches; a centimeter, cm., two-fifths of an inch; and a millimeter, mm., one twenty-fifth of an inch.

J. S. G.

State Normal School, Kutztown, Pa.,
April, 1909.

GENERAL ANALYTICAL KEY

- a. Invertebrates.
 - b. Without legs.
 - c. Aquatic.
 - d. Body protected by 1 or 2 stone-shells.
 - e. Body protected by 2 stone-shells. *Mussels.*
 - ee. Body protected by 1 stone-shell. *Snails in part.*
 - dd. Body not protected by a shell.
 - e. Worm-like. *Leeches, Horse-hair Worms.*
 - ee. Not worm-like.
 - f. Moss-like. *Sponges.*
 - ff. Not moss-like. *Hydra.*
 - cc. Not aquatic.
 - d. Body protected by a stone-shell. *Snails in part.*
 - dd. Body not protected by a stone-shell.
 - Slugs, Earth-worms, Larvae in part, Pupae.*
 - bb. With legs.
 - c. Legs more than 20. *Myriopods.*
 - cc. Legs less than 20.
 - d. Legs more than 10.
 - e. Legs about equal in length.
 - Isopods, Larvae in part.*
 - ee. Legs not equal in length. *Amphipods.*
 - dd. Legs 10 or less.
 - e. Legs 10. *Decapods.*
 - ee. Legs less than 10:
 - f. Legs 8. *Spiders.*
 - ff. Legs 6. *Hexapods, (Insects, mostly mature).*
 - g. Wings none.
 - h. Body constricted between thorax and abdomen. *Ants in part.*
 - hh. Body not so constricted.
 - i. Body protected during part of life by a "scale." *Scales in part.*
 - ii. Body not protected in this way.
 - j. White, 3 tail-like appendages to rear of abdomen. *Thysanura.*

- jj. Not white, these appendages absent. *Orthoptera in part.*
- gg. Wings 2. *Diptera, Scales in part.*
- ggg. Wings 4.
- h. Outer wings different in texture from inner wings.
 - i. Outer wings of uniform texture.
 - j. Outer wings veined, leathery. *Orthoptera in part.*
 - jj. Outer wings veinless, usually horny. *Coleoptera.*
 - ii. Outer wings denser at base than at apex. *Heteroptera.*
- hh. Outer wings of same texture as inner wings.
 - i. Wings with many cross-veins.
 - j. Thread-like tails to the abdomen. *Ephemerida.*
 - jj. No thread-like tails here.
 - k. An apparent break on front edge of fore wing. *Odonata.*
 - kk. No apparent break here. *Neuroptera.*
 - ii. Wings with few cross veins.
 - j. Wings usually covered with scales more or less translucent. *Lepidoptera.*
 - jj. Wings not covered with scales.
 - k. Wings sloping on the body when at rest. *Homoptera.*
 - kk. Wings not sloping this way. *Hymenoptera in part.*
- aa. Vertebrates.
 - b. Skin rough; with scales or fins, or both.
 - c. With scales only; in the turtle group the scales appear mainly on the legs. *Reptiles.*
 - cc. With fins and generally with scales also. *Fishes.*
 - bb. Skin smooth, naked or covered with hair.
 - c. Skin not covered with hair. *Amphibians.*
 - cc. Skin covered with hair. *Mammals.*

SUBKINGDOM PORIFERA

(Sponges)

Sponges (1) abound rather plentifully. They frequently cover sticks and stones that are found in clear streams. They grow coral-like, many in a colony. Fresh-water sponges are gritty when a bit is rubbed between the fingers, and all the varieties we have found here are brownish-gray in color.

SUBKINGDOM COELENTERATA

(Hydra)

The hydra can not readily be seen, unless one takes a glass jar along to the stream or pond. Algae, sticks, etc., with clear water should be placed in this jar. The jar—after allowing it to remain quiet a minute or two—should be looked through toward the light. The hydra are about 5 mm. long and as thin as a pin. One end is fastened to some object, while the free end bears a few tentacles. To preserve them, they should be placed in a vial in a small quantity of water and a crystal of bichloride of mercury added every few minutes to stupify them. At the end of half an hour or so, a large quantity of strong and hot bichloride of mercury should be poured into the vessel holding them. They are killed in this way without having had time to contract. The hydra are then washed and placed in a vial containing 70 per cent. alcohol or 3 per cent. formalin. Two kinds of hydra are readily found—the green, *Hydra viridis* (2), and the brown, *Hydra fusca* (3).

SUBKINGDOM VERMES

(Worms)

The *Gordius* or horse-hair worm (4) is about 2 dm. long and somewhat thicker than a pin; color brown. It is generally believed by those who know no better that this worm developed from a horse-hair, and that it may further develop into a snake. Found in slow-running or stagnant water.

Earthworms (5) and leeches or "blood-suckers" belong here. Several different kinds of leeches are brought in almost every year. The little red leech (6), the *Clepsine* (7)—a very flat and broad specimen with longitudinal lines of black and whitish below, and the gray leech (8) which is reddish-gray above with a row of black dots on each side and yellowish with black dots below, are reported.

SUBKINGDOM MOLLUSCA

(Mussels and Allies)

Mussels or fresh-water clams (9) are the commonest representatives of the bivalves. Snails and slugs constitute the class of univalves. The soft parts of snails are protected by a shell. There is no such protection for the slugs. The common large land snail belongs to the genus *Helix* (10). Three kinds of pond snails are frequently seen. The *Limnea* (11) has a shell about 18 mm. long that forms a sharp right-handed spiral. The *Physa* (12) is somewhat stouter and smaller; its coil is left-handed. To determine a right from a left-handed shell, hold one so that the opening is toward you and the spiral above. If the opening is toward the right, the shell is right-handed; if toward the left, it is left-handed. The shell of the *Planorbis* (13) is coiled in one plane and has a diameter of 12 mm. when mature.

The giant slug (14), *Limax maximus*, attains a length of 8 to 10 cm. and is light brown in color with several rows of black spots on the back and sides. The garden slug (15), *Limax campestris*, is about 15 mm. long and is whitish, gray or black.

SUBKINGDOM ARTHROPODA

CLASS I CRUSTACEA (Crayfish and Allies)

Only a few kinds of fresh-water Crustacea are generally collected. Along the sea-shore this class is abundantly represented. Most of the inland forms are very small. Members of three different orders, however, are fairly large and always common. By means of the following key these orders can be separated:

- a. Large; legs 10, the first pair ending in pincers; eyes stalked. *Decapods.*
- aa. Small or of medium size; eyes not stalked.
 - b. Body oval, flattened dorsally. *Isopods.*
 - bb. Body flattened laterally. *Amphipods.*

ORDER DECAPODA (Crayfish)

The crayfish (16), misnamed a crab, is a Decapod. As is well known, it lives under stones in streams. The short stalked eyes lie in sockets. It swims backward and crawls forward.

ORDER ISOPODA (Sow-bugs)

The members of this order are ususally called sow-bugs, pill-bugs, or wood-lice. Seven similar walking-legs are present. The gray sow-bug (17) does not form a perfect sphere when pricked. The real pill-bug (18) is brownish and under provocation rolls itself into a pill-like ball. Both

281051

are found under stones, etc. The water-louse (19), *Asellus aquaitus*, is found abundantly feeding on decaying vegetation in water.

ORDER AMPHIPODA (Sand-fleas)

The fresh water shrimp (19a) or sand-flea is about 2 mm. long. It has the curious habit of lying on its flattened side when at rest. At the anterior end, along the side, several broad plates are found.

CLASS II MYRIAPODA (Centipedes and Allies)

In the house, under stones or logs, and in many other situations, some of these common, many-legged creatures are apt to be seen. The families can at once be recognized from the following key:

- a. One pair of legs to the segment. (Centipedes).
 - b. Legs long; eight dorsal plates, the last small. *Scutigерids* (20).
 - bb. Legs usually short; 15 or more dorsal plates.
 - c. 15 pairs of legs; dorsal plates apt to be unequal in size. *Lithobiids* (21).
 - cc. 21 or more pairs of legs.
 - d. 21 to 23 pairs of legs; antennae with more than 14 joints. *Scolopendrids* (22).
 - dd. More than 23 pairs of legs; antennae with more than 14 joints. *Geophilids* (23).
- aa. Most of the segments with more than one pair of legs. (Millepedes).
 - b. Body in 19 or 20 segments. *Polydesmids* (24).
 - bb. Body in 30 or more segments. *Julids* (25).

These are the only families found in the collection. Some authors speak of members of certain other families as common. If this is so, it is strange, unless the specimens are of very small size that some one of the hundreds of students collecting has not brought them in. The largest

Myriapod in our range seem to be a species of *Spiribolus* (26), one of the *Julids*. It is cylindric in form, reddish-brown in color and 75 mm. long. Like other *Julids*, it coils up when disturbed.

CLASS III ARACHNIDS (Spiders)

The arrangement and size of the eyes of spiders are ordinarily used to separate the families. The members of the two following families have eyes strikingly unequal in size.

In the *Lycosids* or running spiders (27), the eyes are arranged in three rows; in the first row they are the smallest. The last pair of legs is especially long.

In the *Attids* or jumping spiders (28), the eyes are arranged in three or four rows. The two middle eyes in the front row are the largest; legs short.

The *Thomisids* or crab spiders (29) have eyes nearly equal in size, and are arranged in two rows. The middle pairs usually extend somewhat further forward than the corresponding ones on the outside; two front pairs of legs long, two hind pairs short. The whitish crab spider frequently found in flowers is well known.

In the remaining families, the eyes are equal in size. In the funnel-web weavers or *Agalenids*, the eyes are located in three rows. The middle row is made up of four eyes. The two in front are farther apart than the two in the rear. During the fall this family is abundantly represented by the *Agalena nevia* (30). Two gray stripes in this spider run back from the head over the body-part which has a black line on each side. Long, two-jointed spinnerets extend from the abdomen. The webs are usually made in grass, and they are especially noticeable when beaded with dew.

The *Theridids* or cob-web weavers (31) are the makers of the familiar cob-webs. Eyes in two rows on the forehead; the outer eyes touch, or nearly so.

On the face of *Epeirids* or orb weavers there are four eyes forming a small square. Some distance from this square on each side of the head, a pair of closely-set eyes are placed. These spiders are responsible for those beautiful, vertical, wheel-shaped webs so frequently noticed during fall. *Argiopa riparia* (32) is a long oval spider pointed posteriorly. The cephalothorax or first division of the spider is silvery white. The abdomen is black above, and on the sides is marked by irregular broken bands of white. *Argiopa transversa* (33) is smaller than the last species, and is crossed on the abdomen by a number of black, transverse lines. *Acrosoma* (34) is another common orb weaver; its abdomen is triangular, flat above and edged with several spines. *Epeira* (35) is represented by several very common species. In some species the dorsal part of the abdomen is decorated with highly colored, oriental-like designs. Many of the largest spiders we have, especially those with more or less globular abdomens, belong to this family.

To the spider group belong also the daddy long legs (35a). Their legs are very long and stilt-like; abdomen broadly joined to the head-part. The two eyes are placed near the centre of the head.

CLASS IV HEXAPODA (Insects)

ORDER THYSANURA (Fish-moths)

The only member of this order which is fairly common is the so-called fish-moth (36) or silver-fish. It is seen running over floors like a streak of light. It is about 12 mm. long, and, in addition to the long antennae, it is provided with three bristle-like tails at the rear end.

ORDER EPHEMERIDA (May-flies)

May-fly (37). This insect is frequently caught around electric lights during early summer, or is found near streams during the day.

The four membranous wings are of very unequal size—the hind pair being the smaller. Two slender filaments 40 mm. long project from the caudal part of the body. The fore wings expand about 40 mm.

ORDER ODONATA (Dragon-flies)

Mouth-parts are fitted for chewing. Pupal or resting stage lacking, i. e., the metamorphosis is incomplete. Larva or nymph provided with usually two plate-like gills at the rear end of the abdomen.

Calopterygidae and Agrionidae. In these two families the fore and hind wings on the same specimen are alike in form and size; they are held vertically when at rest; eyes, like tiny balls, are attached to the sides of the head. The members of both families are usually called damsel-flies. The *Agrionids* (38), however, have two cross-veins between the first and second long veins on the front margins of the wings, i. e., between the body and nodus or apparent break about half way out the wing. In the *Calopterygids* there are many such cross-veins. In the latter family, too, the members are more or less colored. A very common species, *Calopteryx maculata*, of this family is black with a green abdomen in the male (39), and is dusky-brown in the female (40). Another species, *Heterina americana*, is colored bright red at the base of the wings of the male (41), and is greenish on the body and has a yellowish tinge on the wings of the female (42).

Libellulidae and Aeschnidae. All dragon-flies belonging to these two families hold their wings horizontally when at rest. The greater part of their heads is covered with eyes; the two pairs of wings have a different-shaped base. The members of these two families can be separated as follows: Counting from the front edge of a wing, notice, near the body, the only cross-vein which connects the third and fourth long vein. In the *Aeschnids* the two long veins have

coalesced into one before reaching this cross-vein. Only a few species of *Aeschnids* are found here. One of these *Epiaeschna* (43) which spreads a full dm., has a rich green, velvety thorax and unspotted wings. A number of *Libellulids* (44) with unspotted wings is common. The two forms of *Libellulids* that are present as a rule in every collection which contains dragon-flies are the *Libellula pulchella* (45) and the *Plathemis lydia* (46). The former is very frequently seen in our range. It spreads 9 cm., and has three dark spots on each wing—a narrow one at the base, one at the middle and one at the tip. The latter, *Plathemis lydia*, is somewhat smaller and each wing shows two dark spots—a small narrow one at the base and the other, near the tip, covering about one-third of the entire wing. When *Plathemis lydia* grows old, the upper part of the abdomen becomes covered with a whitish powder.

The opinion is held by some credulous folks that these dragon-flies lead a symbiotic life with snakes. They lack a sting and are otherwise perfectly harmless. People, generally, have never held them in high favor. A few of the following popular names applied to them show this: “devil’s darning needles,” “flying adders,” “horse stingers,” and “mosquito hawks” are some of their names.

Indeed the last, “mosquito hawks,” is the most appropriate, for both nymph and adult act well their part in ridding our water-courses of pestiferous mosquitos.

ORDER ORTHOPTERA (Grasshoppers and Allies)

Mouth-parts formed for biting; hind wings fold like a fan when not in use. No pupal or resting stage, i. e., the metamorphosis is incomplete. The larva or nymph is characterized by the lack of wings and by a relatively large head.

The five families of this order can readily be determined

and their most striking characters noted by the following analysis:

- a. Femur of hind leg enlarged. (The femur is the first long division of a leg, counting from the body.)
 - b. Antennae shorter than the body. *Acridids.*
 - bb. Antennae as long or longer than the body.
 - c. Outer wings, if present, sloping. *Locustids.*
 - cc. Outer wings, if present, bent at right angles. *Gryllids.*
- a. Femur of hind leg not enlarged.
 - b. Body oval. *Blattids.*
 - bb. Body linear. *Phasmids.*

Acrididae. The members of this family are popularly known as grasshoppers, but, entomologically, as the locusts or short-horned grasshoppers. The *Carolina locust* (47) has black wings bordered with buff, a prominent depression is in the broad, keeled, sun-bonnet-like collar back of the head. Common around road-sides during August.

The red-legged locust (48) takes its name from its red femur. While there are a few other species in Pennsylvania with red tibiae, this one is exceeding abundant during fall in cultivated fields. It is destructive to tender vegetation. Length of body, 24 mm.

The yellow-winged locust (49) displays a sulfur-yellow color on the inner two-thirds of its wings, the outer third is mostly dusky-brown.

Locustidae. Four groups make up this family.

1. The members of the first group are usually small, green, and are provided with very long and delicate antennae. The commonest form (50) here has a reddish-brown band on the back. Meadow grasshopper is the general term applied to the members of this group.

2. To this division belong those large forms which usually live on trees and sing, "Katy did, Katy did; she did, she didn't." They go by the name of katydids. Four

different kinds of katydids are known to occur in this range. Eggs, flat and oval, 5 mm. long, are laid in rows in an overlapping fashion on leaves or twigs.

In the *Scudderia* (51) the outer wings are equal in breadth throughout and shorter than the inner wings.

The outer wings of *Microcentrum* (52), the commonest form, are broad in the middle and taper toward the ends.

The beak of the *Conocephalus* (53) is conical, and the body-part is long and slender.

The outer wings of *Cyrtophyllus* (54) are oval, obtuse and rounded at the ends, and concave or hollow below. These wings, too, appear strikingly leaf-like. Right before the insertion of the wings in the male, the glassy musical apparatus can easily be seen.

3. In this group, collectively known as the shield-backed grasshoppers, the dorsal collar shaped like a sun-bonnet, is very large. Wings vestigial, concealed under the posterior extension of the shield or bonnet. This shield in *Atlanticus* (55) narrows anteriorly; the lateral and dorsal portions meet at a blunt angle where there is a prominent line.

4. No wings are found on the cricket-like grasshopper (56). The quiet life under stones, etc., which brought about almost complete atrophy of the wings of the shield-backed forms, has entirely taken away the wings of the cricket-like forms. In the rear legs of the males, the tibiae, or long slender parts of the legs, are curved. In both sexes, the femora of the hind legs—the thick division—are grooved beneath. Body prominently arched.

Grillidae. Three different groups of crickets are found.

1. All the true crickets (57) are black. Hind tibiae armed with a double row of spines, distal spines longest.

2. The anterior legs of the mole crickets (58) are fitted for burrowing. Large, cinnamon-brown.

3. The tree crickets (59) are delicate, whitish-green insects. When at rest the wings are folded over the body,

which then has a long triangular shape. Two appendages project from the rear of the flat abdomen. Found most frequently on the bark or leaves of trees.

Blattidae. The cock-roaches (60) are of two kinds—the winged and wingless. They are broad, oval, flat and usually of a chestnut color.

Several different species occur in houses of Pennsylvania. A little brown species is found under wood and stones.

Phasmidae. The walking-sticks (61) are spectre-like insects. Their bodies are very long, narrow and wingless; legs and antennae, thread-like; movements slow. When young their bodies are green, but later they become brown. Difficult animals to see in their habitats which are trees and shrubbery.

ORDER HEMIPTERA (Bugs and Allies)

No pupal or resting stage, i. e., the metamorphosis is incomplete. Mouth-parts formed for sucking. Three sub-orders are made from this group.

1. Wings of uniform texture, sloping when not in use and not overlapping their opposites. Certain species wingless. *Homoptera.*

2. Each outer wing not of uniform texture—dense at the base and transparent toward the apex; outer wings when at rest overlapping their opposites posteriorly. *Heteroptera.*

3. All wingless and parasitic. *Parasitica.*

(*Homoptera*) (Cicadas and Allies)

Cicadidae. These are the so-called locusts, or entomologically the cicadas or dog-day harvest-flies. The *Cicada septendecim* (62), or “the seventeen year locust,” is somewhat smaller than the *Cicada tibicen* (63). In the former

the main wing-veins, the eyes, and legs are yellow. In the latter, the large vein of the front wing and the marks on the body are green; eyes gray and lower part of abdomen white.

Cercopidae. On alders, particularly, there is apt to gather during the fall a whitish froth, which, if examined, is seen to contain a number of the so-called spittle-insects (64). Their tibiae are provided with one or two stout spines. Small.

Jassidae. The leaf hoppers (65) are distinguished by having a row of spines on each side of the hind tibiae. During summer and fall they are very abundant on certain leaves. Small.

Membracidae. The tree hoppers (66) are a most peculiar-looking set of insects. In many species the body part projects above the head or abdomen into a horn. Very common during fall. Small.

Aphididae. Plant lice (67) are usually pear-shaped and less than 6 mm. long. Legs, long and thread-like. Some wingless. They are usually found, many together, heads pointed in the same direction on almost any kind of tender plant. Parthenogenetic.

Coccidae. This family ranks first from an economic standpoint, since the scale insects belong to it. The "armor" of the female (68) San Jose scale is circular, from one to two mm. in diameter; the armor of the male (69) is somewhat smaller and rather oblong. At the centre of the female's armor and near the centre of the male's there are usually two small concentric depressions, in the centre of which there is a nipple-like elevation. This scale is unquestionably the most destructive insect pest in Pennsylvania to-day. When young they are white or black and when old gray.

The female (70) oyster-shell scale, larger than the preceding, is about three times as long as wide, and is shaped

like a long, slender oyster or a long section of a curved pear. The male (71) is shorter.

The female (72) scurfy scale is about 3 mm. long, and appears like an irregular, dirty-white expansion from a yellowish beak. The male (73) has about the same length, but is very narrow and is provided with three ribs.

The Lecanium scale (74) is about 5 mm. long, usually brownish in color and is shaped like the upper part of a box turtle.

Certain forms fairly common can hardly be separated from the San Jose scale by their structure except by means of a microscopical examination. Putnam's scale and the European fruit scale have a close resemblance to the San Jose scale, but in the field, the presence of a reddish discoloration around and beneath any circular form, marks it at once as the San Jose scale.

(Heteroptera) (True Bugs)

The first four families are aquatic and their members live in the water. Antennae short. Certain members leave the water to try their wings and lured by strong lights are often caught there.

Corsidae. Water-boatmen (75) are oval, gray and black. The most common form is about 10 mm. long. The head overlaps the first part of the body, and the greater part of the long front legs are fringed with hairs. In the water they are usually surrounded by a layer of air, which gives them a silvery appearance.

Notonectidae. Back-swimmers (76) swim as their name implies on the back. They carry a bubble of air beneath their wings. Hind legs very long and fitted for swimming.

Nepidae. The water-scorpions have two thread-like respiratory organs projecting from the rear of the body.

Front legs fitted for grasping. The form we have here, *Ranatra fusca* (77), is 40 mm. long and 5 mm. wide.

Belostomidae. In the giant water-bugs all the legs are flattened or fitted for an aquatic life. A pair of flat tails project from the body. *Belostoma americanum* (78) is 65 mm. long and 25 mm. wide. Because this giant specimen is frequently caught around electric lights it is popularly known as the electric light bug. They are reputed to be very destructive to small fish.

Hydrobatidae. Water-striders (79) are long and fairly slender; antennae 5 mm. long; first pair of legs short, second and third pairs very long. Almost any time of the year one should be able to see these frail insects "striding" the surface of the water. Length, 15 mm.

The following families are land forms; excepting the last family, they all have four-jointed antennae, which are long.

Tingitidae. The beautiful lace bugs (80) are found under loose bark of certain trees, for example, the sycamore. They are rectangular, flat and inlaid with fine meshes of delicate white net. Four mm. long and two mm. wide. Body black.

Emesidae. We have seen hundreds of these thread-legged bugs (81) together during the fall on arbor-vitae hedges. Wings short. Body 35 mm. long and 2 mm. wide; hind legs 50 mm. long and one-third mm. wide; tarsi and tibiae of front legs generally bent together as for grasping. Beak, three-jointed.

Reduviidae. The members of this family generally have snake-like heads and flat or concave abdomens. Their beaks rest in grooves between the front legs when not in use. The kissing bug (82), which created such a furore during the summer of 1898, is black or nearly so, 10 mm. long and is constricted back of the head. The general name for the

members of this family is assassin-bugs (83). Beak, three-jointed.

Nabidae. The damsel bugs have a four-jointed beak. Two kinds are frequently found—the blonde (84) and the black (85). The wings are very short and the body is soft and fleshy. Shape, pear-like. The blonde one is pale yellow, dotted with brown, and is 8 mm. long; the black one is jet black; legs and sides of the abdomen yellowish.

Acanthiidae. Bed-bugs (86) are pretty well known to most people. They are flat, oval, wingless, reddish-brown and about 5 mm. in length. Beak three-jointed.

Coreidae. The squash-bugs (87) are separated from others with a four-jointed antennae by the fact that the transparent part of the outer wings contains many, mostly forked, veins, which arise from a cross-vein near the limit of the thin part of the wing. The squash-bug is brownish-black spotted with yellow on the edges of the abdomen; it is 15 mm. long and 5 mm. wide. These have even a more pungent smell than the next.

Pentatomidae. The stink-bugs do not belie their name; Antennae five-jointed; body stout and broad; shoulders square; a large triangular plate projects backward from the base of the wings. *Nesara pennsylvanica* (88) is green, and is 15 mm. long and 10 mm. wide.

(*Parasita*) (Lice)

These are the lice. They live on man and beast.

ORDER NEUROPTERA (Dobson and Allies)

Pupal or resting stage present, i. e., the metamorphosis is complete. The members of this order are flesh-eating and are, therefore, provided with jaws. Three families are well represented.

Sialidae. The prothorax or part back of the head, when viewed dorsally, is quadrangular in shape. The dobson (89) and the *Chauliodes* (90) represent this family. In general features they resemble each other, but the latter differs from the former in the absence of horns and in the presence of feathery antennae and in its smaller size. The dobson has long thread-like antennae and in the male fierce-looking horn-like jaws. Its grayish wings expand 12 cm. The larva of the dobson, called hellgrammite (91) by anglers, has three pairs of legs. It shows the characteristic quadrangular prothorax.

Chrysopidae. Lace-winged flies (92) have golden eyes, greenish wings which are narrow at the base and long thread-like and delicate antennae. We find them in profusion during September on sweet peas. The eggs (93), supported by rigid, slender stalks, are placed on some leaf. The stalks are probably 10 mm. long and the oval eggs about 1 mm. thick. The larva (94), a large jawed specimen, is credited with eating San Jose scales.

Myrmeleonidae. Ant-lions (95) have the same general appearance as the *Chrysopas* but are usually stouter and of a grayish color. Their antennae are clubbed at the end. The larvae resemble ants with huge jaws.

ORDER LEPIDOPTERA (Moths and Allies)

Pupal or resting stage present, i. e., the metamorphosis is complete. Mouth-parts developed into a tube for sucking. Three divisions are usually made out of this order.

1. Moths. These usually fly at night; antennae thread-like, feathery or partly so; body usually stout; pupal stage frequently protected by a cocoon; wings held horizontally when at rest.

2. Skippers. Body stout; day-fliers, darting suddenly from place to place or "skipping"; wings usually vertical

when at rest; antennae thread-like, thickened near the tip, which is in the form of a hook.

3. Butterflies. Gaily colored, as a rule; bodies slender; antennae with flattened knobs distally; wings vertical when at rest; pupae naked, more or less angulated, and because they are occasionally spotted with golden dots are generally called chrysalids; day-fliers.

1. (*Moths*)

Saturnians. The *Saturnians* make up a large so-called super-family which is divided into two families. The members of this group are medium or large in size—most of the largest moths belong here; chest woolly; antennae feathery (males); fore wings broad. The hind wings are expanded at the base so that the anterior margin extends under the posterior margin of the fore wing.

Citheroniidae. The royal moths most apt to be seen here are two in number. The wings of the regal moth (95a), *Citheronia regalis*, spread about 15 cm. Fore wings olive spotted with yellow; veins red. Hind wings orange-red. The larva, known as the horned devil (96), is fully 13 cm. when mature and well-fed. Near the anterior end there are four sets of reddish horns tipped with black; they are about 15 mm. long. Ground-color green. The pupae (97) are naked and are provided with a forked spine at the posterior end; this spine is 1 mm. long.

The imperial moth (98), *Citheronia imperialis*, is similar in size and form to the regal. Ground-color, sulfur-yellow. A band of reddish-brown crosses each wing. The larvae (99) usually brown in color, are sparsely clothed with hair. The second and third segments are each furnished with a pair of short, light colored horns. The forked spine on the brown pupa (100) is 6 mm. long. The males of the royal moths differ from the females in the fact that in the

females the antennae are thread-like while in the male they are feathery for one-half of their length.

Saturniidae. In the males of this family the antennae are feathery throughout. The general name for members of the family is, the giant silk-worms.

The female Io (101), *Automeris io*, is purplish-red; its wings expand about one dm. Near the middle of each rear wing there is a large dark eye-spot, the centre of which is blue. The male (102) is smaller than the female and has a yellow instead of a purplish-red color. The larvae (103) are armed with several rows of green-clustered spines. If these spines prick the tender skin, a sharp pain results. The sides of the larvae are reddish and white striped; general color green.

The Polyphemus moth (104), *Telca polyphemus*, is a very large buff-colored specimen. An isinglass-like spot, bisected by a vein is present on each wing. Before this clear spot on each hind wing there is a cloud of black scales. The larvae (105) are pea green in color; there are several rows of orange-colored tubercles each tipped with a few hairs, extending the length of the body. The cocoon (106) is enclosed within a leaf.

The Luna moth (107), *Tropea luna*, is a large, Nile-green insect. The anterior margin of the body and fore wings is brown. The long swallow-tail extensions to the rear wings are very characteristic. On each wing a transparent semi-circular spot is found. The bluish-green larva (108) has a pearl-colored head. Along each side there is a pale yellow stripe. The cocoons (109) resemble those of the two preceding forms.

The Promethea moth, *Callosamia promethea*, is more slender than any other *Saturnians* here described, although its wings spread slightly more than those of the Io moth. The ground-color of the female (110) is light reddish-brown. A whitish line crosses each wing. Near the mid-

dle of each wing, too, there is a clay-colored, angular spot. In the male (111) the reddish-brown of the female deepens into a dark brown or to a dull black, and the transverse lines and angular spots are absent or nearly so. The full-grown larvae (112) are about 50 mm. long and of a bluish-green color. Several rows of black shining prominences extend down the body. Immediately back of the head there are two pairs of prominent red spines and near the rear end a yellow one. The cocoon (113) encasing the pupa is made by tucking together the edges of a leaf. Because the larva strengthens and securely fastens this leaf with its petiole to the twig with strong silk, it is frequently observed through the winter as it dangles in the air. This cocoon is about 7 cm. long and is generally found around water courses, especially on spice-bushes.

The Cecropia moth (114), *Samia cecropia*, is the largest moth we have. The wings of our laboratory specimen expand 17 cm. At first sight the coloration of this moth resembles that of the Promethea. The ground-color, however, of the Cecropia is a smoky brown. The margin of the wings like that of the Promethea is clay-colored. Instead of an angular-shaped spot on each wing, there is a crescent-shaped spot, the anterior of which is white and the posterior red. The larva (115), also bears a general likeness to that of the Promethea. The general color is similar. Two pairs of red spines are likewise found near the head. The color of the tubercles, however, in the six rows extending down the body is yellow, and each is beset with a few black bristles. The cocoon (116) frequently found in the crotch of small limbs is nearly a dm. long and very bulky. In its papery structure no leaves are used; its color like that of the other members of this family, is a dull gray or brown and, of course, harmonizes with its background.

Noctuidae. The owlet moths have hair-like antennae, narrow elongated fore wings, which are frequently marked

with zigzag cross-lines and peculiar eye-spots. When at rest the wings are folded in such a way as to give them a triangular appearance. These moths are of medium size, usually grayish-colored and stout-bodied. The majority of those seen around lights after dark belong here. Many of those that fly up before us as we walk across fields during the fall are owlets. Their bright shining eyes suggest tiny owls. The largest forms that are common have a pair of broad black bars, on the hind wings. These bars alternate with red, yellow or white. These owlets are called *Catocalas* (117).

Geometrinæ. To this super-family belong a host of slender bodied, frail winged forms. The ground-color and markings on both pairs of wings are generally alike. The middle legs of the larvae are usually wanting and they go "looping" along as they walk. For this reason they are called "loopers" or *geometrids*, earth-measurers.

The canker worms are the most important *geometrids*. The spring canker worms (118) are "marked on the back with eight narrow, pale, longitudinal lines which are barely discernible; the two lateral lines of each side are much further apart than the others." The fall canker worms (119) are "marked on the back with six broad and very distinct pale lines, those of each side equidistant"; on the fifth abdominal segment there is a pair of legs. The adult females are wingless and both sexes of the two species have "two transverse rows of stiff reddish spines on each of the first seven abdominal segments." These canker worms are very destructive to the foliage of the fruit and shade trees. The adult chick-weed geometer (120) is reddish yellow, with two cross-bands of pink. The chain-dotted geometer (120a) has white wings crossed by zigzag lines and black dots; head yellow in front; base of wings yellow. The notched-wing geometer (120b) is yellow; the outer part of wings brown spotted.

Sphingidae. The hawk-moths or sphinxes have very robust and spindle-shaped bodies. The antennae are thread-like, slightly hooked at the outer end and perceptibly thicker near the middle. The larvae are easily recognized by the presence of a horn or shining knob on the eighth abdominal segment.

The tomato-worm moth (121), *Phlegethontius celeus*, is exceedingly common around electric lights during certain summer nights. Its ashy-gray wings expand a dm. or more. The gray abdomen is ornamented by five yellow patches on the side and each patch is bordered with black. The larvae (122) varying in color from green to brown are very large. The naked pupa frequently dug up in gardening has a pitcher-like handle at one end.

The tobacco-worm moth (123), *Phlegethontius carolina*, resembles the preceding in all its stages. The adult, however, is brownish-gray and the two dark bands crossing the middle of the hind wings are not zigzag as in the former.

Pandorus sphinx (124), *Philampelus pandorus*, also expands more than a dm. The ground-color is pale olive, which is marked by darker shades of pale yellow.

The white-lined sphinx (125), *Deilephila lineata*, is a large moth, olive brown in color, and the veins of the fore wings are white lined. The Thysbe clear-wing (126) *Hemaris thysbe*, is peculiar in that the central part of the wings are scaleless or transparent. General color, a dark reddish-brown with a broad yellowish band around the body. Expansion of wings, 50 mm.

Arctiidae. The tiger-moths are usually gaily colored or striped. Their appearance is suggestive of the name. Some of these moths, however, are pure white. Bodies stout; ocelli, or simple eyes between the big eyes, present; wings usually slanting on the body when at rest. Most of our common hairy caterpillars belong here.

The Bella-moth (127) spreads about 40 mm. Hind

wings pinkish; the outer margin black; fore wings orange-colored crossed by a number of irregular white bands dotted with black.

The Isabella tiger-moth is very often seen in its larval form (128). This larva is a furry caterpillar, reddish-brown in the middle and black at each end. During the fall especially it is a common sight to see this fellow hurrying over walks. The tawny yellow adult (129) spreads some 50 mm. It is spotted with black, and on the back and sides of the abdomen there is a row of six black dots.

The Eyprepia tiger-moth (130) has a striking appearance. Fore wing jet-black, checkered by pinkish-yellow bands; rear wings reddish to orange, margined by black. Expansion of wings, 65 mm.

Yellow-bear. *Spilosoma virginica*. The larvae (130a) are the very common, yellowish, hairy caterpillars. Some of the hairs are longer than the others. The color may change to a reddish or brownish with a darker line on the side. The adult (130b) is white with a row of black dots on the back and sides of the abdomen between which there is a yellow stripe.

The fall-web worm (130c) is very common during the fall on apple and other trees. Many of these caterpillars are seen together in one web. The webs are more extensive than those of the tent caterpillar, which they resemble.

The salt-marsh caterpillar moth (130d) is white. A row of black dots on the back and sides of the abdomen. Many black dots on the wings. In the male the hind wings and the lower surface of the fore wings are yellow.

Tineinas. The *Tineina* super-family includes only very small specimens which are at once distinguished by the wide fringes which border the hind wings. To this group belong the clothes-moths (131) and the Angoumois grain-moth (132). During the winter of 1908-09 hundreds of dollars worth of stored grain in Berks County was affected

by the larvae of this grain-moth; the larvae (133) live inside the grain. The larvae (134) of the clothes-moth usually make cases from bits of clothing.

Sesiidae. The clear-winged moths resemble wasps in appearance. The peach-tree borer (135), *Sannina exitiosa*, is steel blue in color. In the female (136) the fore wings are covered with scales and there is a bright orange-colored band on the abdomen. Both wings of the male (137) are "clear" and the orange-colored band is lacking. The larvae (138) live between the wood and bark at or near the base of the peach tree. The flow of gum mixed with wood particles indicates their presence. Coal tar and "digging them out" are the two best methods of control.

Notodontidae. The members of this family are most generally collected in the larva or caterpillar stage, and the caterpillars most often seen belong to the hand-maid moth genus, *Datana*. *Datana ministra* (139) is stout bodied, brown in color and is marked by a prominent area of rich brown on the fore part of the body; the larva (140) called the yellow-necked apple-tree worm is black or reddish marked by longitudinal stripes of yellow or white, it has the curious habit of raising its extremities, especially when touched.

The walnut caterpillar (141), *Datana angustii*, when full grown, is nearly black with three very narrow pale-yellow stripes on each side; hairs on body dirty white. Like the last specimen this is gregarious in its habits. It is our worst enemy of the walnut tree. They frequently strip a large tree of its foliage. Their molted-off skins are deposited in a mass around the tree trunk.

Tortricina. To this super-family belong the so-called leaf-rollers. The square ends of the broad fore wings is a good character to distinguish the adults. The larvae of many of them live within rolled-up leaves. The most important member of this group is the codling-moth (142), *Carpo-*

capsa pomonella, which is probably more destructive to apple orchards than any other lepidopterous insect. The small flesh-colored larvae (143) live on the seeds of the apple, and when full grown emerge from the fruit to transform. The mature moth (144) is small; fore wings rosy or grayish mottled, near the tip of which are golden bands.

Lymantriidae. The tussocks are characterized in the larval stage (145) by the presence of brightly colored tufts of hair especially on the dorsal side. In the adult the legs are clothed with woolly hairs. The pestiferous gipsy-moth belongs here.

Lasiocampidae. Like in the *Saturnians*, there is in this family a lobe at the base of the anterior margin of the hind wing. This lobe extends under the fore wing. The tent caterpillar moth (146), *Clisiocampa americana*, is best known in its larval stage. In early spring the "tents" or webs of these caterpillars are common on the apple and wild black-cherry trees. Like the larvae of the hand-maid moths these specimens are gregarious; head and body black; a white dorsal stripe down the back; over the entire body there is a sprinkling of yellowish hairs. The eggs (147) are glued together in a mass which surrounds the twig. The mature moth is reddish-brown; the fore wings are crossed by two whitish lines. Totype (148) is stout bodied, densely clothed with milk-white or buff-colored hairs; back blackish; wings pale-brown, crossed by irregular whitish bands.

Eucleidae. The slug caterpillar is slug-like in appearance. The most interesting phase is the caterpillar (149). A common form, the saddle-back caterpillar, has a brown oval spot on the back. The prick of its spines is painful.

2. (*Skippers*)

Hesperiidae. The silver-spot skipper (150) spreads about 50 mm.; color rich brown. The fore wings are marked by one large and a few small pale-orange blotches.

On the under side of hind wings there is a prominent silvery patch. The flattish-brown heads of the larvae are separated from the greenish body by a strongly constricted neck. Other small skippers (151) are caught. As a rule these are dusky brown in color with a few light spots on the fore wings. Some (152), however, have a pale-orange color on part of the wings.

3. (*Butterflies*)

Papilionidae. The members of this family are of large size and have a tail-like extension to each hind wing. The prevailing color is black, enriched by yellow, blue or green markings. The larvae are characterized by the presence of a pair of fleshy horns which can be extended and retracted, giving them a terrifying aspect. The chrysalids are either suspended from the posterior end or supported at an incline by a web of silk fibres about the waist.

Black Swallow-tail. *Papilio polyrenes*. In the male (153) there is a double row of bright spots parallel with the outer margin of the wings, the inner one of which is the heavier and in the fore wings these spots are triangular with the sharp angles pointing toward the body. On the dorsal side of the abdomen of both sexes there are two rows of yellow dots. In the female (154) the inner rows of spots on the wings are apt to fade out, but the presence of the yellow spotted abdomen identifies it. The larvae (155) are green and on every division of its body there is a transverse band of black. These bands are nearly broken into transverse spots. Food-plants, carrots and parsley. The chrysalis (156) is about 30 mm. long, is forked at the anterior end and is supported at an oblique angle by the tail and a girth of waist-fibres.

Green-clouded Swallow-tail (157). *Papilio troilus*. Near the outer margin of the upper surface of the hind wing there is a row of six, more or less, crescent-shaped spots.

These are pale blue-green in color. Before these, in the male, there is a cloud of green scales; in the female this cloud is bluish.

Tiger Swallow-tail. This butterfly exists under two forms—the black and the yellow. Either sex may be yellow, but the black form is not only always a female but is found mostly south of Pennsylvania. The ground-color of the yellow form (158), *Papilio glaucus turnus*, is bright yellow; the outer margin of the wings is black; fore wings crossed by four cross-bars. The dark form (159), *Papilio glaucus glaucus*, is frequently confused with the female of the green-clouded swallow-tail or with that of the black swallow-tail. It is separated at once from the latter by the absence of spots on the abdomen above and from both by the presence of a black band separating the bluish scales on the upper surface of each hind wing, and by the additional fact that it has a long black cross-bar on the under surface of each hind wing. The mature larvae (160) are dark green. A short distance back of the head are two greenish eye-spots edged with black. Back of these spots there is a transverse black line.

Blue Swallow-tail (161). *Laertias philenor*. The under surface of each hind wing is marked by a row of seven large, mostly orange-colored spots which are connected and bordered by jet-black scales. On the upper sides of these wings, the greenish-blue scales gleam like metallic reflections. There is a marginal row of crescent-shaped spots on the upper surface of each hind wing. In the female these rows extend almost over the fore wings, while they are not represented or very faintly so in the male.

Giant Swallow-tail (162). *Papilio thoas*. This is the largest butterfly in North America. Our laboratory specimen spreads 13 cm. Ground-color above black and below yellow. Two rows of more or less confluent, bright-yellow spots cross each wing above. Those on the anterior wings intersect. The larvae (163) are enlarged in front. At

each end in the middle there are patches of creamy-white. General color reddish-brown. It is most fascinating to watch these caterpillars extend and retract their fleshy horns. We find them most frequently on the prickly ash.

Zebra Swallow-tail (164). Where the pawpaw flourishes there one should find the zebra. The adult is trimorphic, i. e., it occurs under three distinct forms. These differ chiefly in the length and size of the tail. Wings beautifully banded with stripes of rich brown and yellowish white. Near the posterior angle of each rear wing there is a prominent scarlet blotch.

Pieridae. To this family belong our most common butterflies. Over fields and roads, in yards and gardens, in streets and parks, almost everywhere these medium sized white, yellow or even reddish-orange forms may be seen.

Of the "whites" the cabbage butterfly, *Pieris rapae*, is most apt to be seen. This insect was introduced from Europe in 1860, and like the English sparrow is now distributed over all of North America. Its larva (165), the little green worm of the cabbage patch, is truly a pest. As is often the case with butterflies, this species occurs in two distinct forms or is dimorphic. Above, the wings of the common form are white; below, the hind wing is white tinged with yellow. On the upper side of each fore wing, there are two dark spots in the female (166) and only one on the male (167).

The checkered white (168), *Pontia protodice protodice*, in its typical form is checkered toward the tips of the fore wings with large dusky spots.

The "yellows" are best represented by the roadside butterfly, *Eurymus philodice*. Above, the wings are yellow bordered with blackish-brown. This border is considerably wider in the female's (169) fore wing than in the male's (170), and it also contains a few yellow spots which the male's border does not show. This species is also dimorphic. In Eastern United States there are nine yellows.

Nymphalidae. In this family the front legs are very short and vestigial; they lie close to the breast and are of little or no use in walking. The members of the two following families are also four-footed, but each, as indicated later, is possessed of certain other characters which separate them.

There are five groups of *Nymphalids*: The fritillaries, the crescent-spots, the angle-wings, the sovereigns and the emperors.

1. *Fritillaries.* Almost all the butterflies with silvery-white spots on the hind wings belong here, although some fritillaries lack these spots. Ground-color reddish-yellow, marked and dotted with black. Club of antennae short and abruptly thickened.

The regal fritillary, *Speyeria idalia*, is the largest, spreading about 1 dm. In the female (171), the upper surface of the hind wings is mostly black marked by two irregular rows of white spots. In the male (172), which is somewhat smaller, the tawny black on the upper surface of the hind wings is marked by a marginal row of reddish-yellow spots.

The great spangled fritillary (173), *Argynnis cybele*, is distinguished by a prominent, buff, sub-marginal band, 5 mm. wide, on the under surface of each hind wing.

In the silver-spot fritillary (174), *Argynnis aphrodite*, this buff band is inconspicuous or only about 2 mm. wide. This band in the last two species, separates the two outer rows of silvery spots.

The silver-bordered fritillary (175), *Brenthis myrina*, expands about 4 cm. The border of silver-spots on the under surface of the hind wings is enclosed by an area of reddish-brown scales which extend to the limit of the outer wing margin.

In the variegated fritillary (176) and in the next species the lower side of the wings lacks the silver spots. On the upper surface of each fore wing, near the front margin

and toward the base, there is a prominent pale area edged with black and on the upper side of each hind wing there is a conspicuous row of four black dots, one of which, however, is very small.

The meadow fritillary (177), *Brenthis bellona*, expands about 40 mm. Near the front margin of each fore wing, on the lower side, toward the base, there are two black-bordered eye-like spots which are separated by a short, black, broken line.

2. *Crescent-spots*. These are usually small and marked with a prominent black border. On the upper side of each hind wing there are a few indistinct crescent-shaped spots, and margining this border on the inside there is a row of six eye-spots more or less distinct.

Pearl Crescent (178). In the black border on the upper side of each hind wing there are a few indistinct, crescent-shaped spots, and margining this border on the inside there is a row of six eye-spots more or less distinct.

3. *Angle wings*. All of our angle-wings excepting the buckeye have hairy eyes. The outer margin of the wings is more or less angular or notched.

The red admiral (179), *Vanessa atalanta*, has a broad reddish-orange band bisecting each fore wing. The outer margin of each hind wing is widely bordered with orange, within which there are about four black dots.

Painted Beauty (180). *Vanessa huntera*. On the lower surface of each wing there are two large, circular, eye-like spots of unequal size. Wings above are black and orange.

Cosmopolite (181). *Vanessa cardui*. The coloration of the upper surface of the wings closely resembles that of the painted beauty. Near the outer margin of the lower surface of each hind wing there are four or five eye-like spots of unequal size.

Mourning Cloak (182). *Euryanessa antiopa*. Wings black bordered with whitish-yellow. Close to the border above there is a row of purplish spots. This and the next

two species have very irregular outer wing margins, which irregularity in the rear wings has produced tail-like appendages. The larvae (183) of the mourning cloak are black and spiny, and are adorned with a row of red dots along the back.

The violet tip (184), *Polygonia interrogationis interrogationis*, is distinguished by the fact that it has, on the middle of the under surface of each wing, two small silvery marks—the one in the form of a dot and the other in the shape of a crescent which partly encircles the dot. The tail-like tips and the outer wing margin of the hind wings are violet.

The hop-merchant (185), *Polygonia comma comma*, closely resembles the violet tip. The silvery marks are in the form of a C or G, there being usually only one on each hind wing. Below, the wings are a mottled-grey, variegated by a rich brown.

Buckeye (186). *Junonia cenia*. Toward the outer part of each hind wing above there are two eye-spots, the anterior one of which is the larger. On each fore wing there is an irregular white band which partly encloses a large eye-spot.

4. *Sovereigns*. Outer end of antennae increases in thickness very gradually. The first three veins of the hind wings separate at the same point.

Red-spotted purple (187). *Basilarchia astyanax*. The ground color of this and of the next species is black. On the outer margin of each hind wing there is a double row of crescent-shaped purplish spots, on the border of which there is a black and a purplish band. General color of rear wings, purplish black. No white on front wings above.

Banded purple (188). *Basilarchia arthemis*. Both wings are crossed by a broad white band.

Viceroy (189). *Basilarchia archippus*. Ground color of wings yellowish-orange. This specimen closely mimics

the monarch. It, however, is smaller and has a transverse, narrow black band crossing the wings.

5. *Emperors*. The tawny emperor (190), *Chlorippe clyton*, is apt to fly upon a person when in the field. Close to the margin of the hind wings above there is a row of five or six black dots, and on the under side of these wings, on a back ground of pale lilac, these dots are smaller and purplish.

Agapetidae. These are the meadow-browns. The vestigial fore legs are folded like a tippet on the breast. The first vein of the fore wing especially, as it leaves the body, is greatly thickened.

The blue-eyed grayling (191), *Cercyonis alope alope*, is dark brown. A broad pale-yellowish band crosses the outer part of each fore wing, within which there are two black eye-spots whose centre is blue. The blue, however, may be absent. Wing expansion, 5 cm.

The little wood satyr (192), *Cissia eurytus*, is smaller than the former species. Wings, a subdued grayish brown. A pale broad band crosses the wings on both sides near the margin, and within this band, on each wing, above and below, there are two or more black spots edged with yellow.

Lymnadidae. The milkweed butterflies are of a large size. The rounded tips of the front wings are extended. There is an absence of scales on the antennae. Four-footed.

The monarch or milkweed butterfly (193), *Anosia plexippus*, is probably the most common of our larger butterflies. Wings orange-brown bordered with black. Veins black. On one of the veins of each hind wing above, the males have "perfume pockets" which are black and 1 by 3 mm. in size. Wing expansion, 1 dm. The larvae (194) are crossed on each segment with black and yellow stripes: at both ends there is a pair of whip like horns, the front pair, however, are the longer. Food-plant, the milkweed. The chrysalis (195) is about 25 mm. long and near its pedi-

cel there is a black, semi-circular line dotted with golden spots.

Lycanidae. The members of this family have six well developed legs. They are all small in size. Whitish rings usually encircle the eyes and the filaments of the antennae. They generally are divided into three groups: The hair streaks, the coppers and the blues. The general term for the family is the gossamer-winged butterflies. Small.

Hair-streaks. These are commonly dark brown in color and are provided with hair-like extensions to the hind wings. They usually have a scarlet blotch on the hind wings on the under side and are variegated with white and pink below.

Coppers. These show a copper tinge on the wings. The wanderer (195a) and the American copper (196) we find most frequently. In the former the color is a faded brown with large patches of buff. Wing expansion, 30 mm. In the latter there is a broad orange-red band on the outer margin of the hind wings, and on the coppery-red fore wings there are a number of black spots. Wing expansion, 25 mm.

Blues. Most of the members of this group are decidedly polymorphic, and are, of course, difficult to identify. The spring azure (197) occurs under five different forms. The under surface of the wings is ashy-gray and dark spotted. There are no red spots on the hind wings. Generally the tips of the fore wings are darkened. Ground-color blue. Wing expansion from 25 to 33 mm. Very common. Some of the blues, too, have tails like the hair streaks. The tailed blue (198) expands 25 mm. and has a red spot on the outer edge of each wing.

ORDER DIPTERA (Flies and Allies)

Pupal or resting stage present, i. e., the metamorphosis is complete. Back of the wings on each side there is a balancer or thread with a knob at the distal end. This is a

difficult group to study. The flies play an important part in the economy of life. They are not frequently collected, however, on account of their small size, apparent lack of beauty, and difficulty in identification. Many families of insects are separated by the wing-venation. Each vein has its peculiar name, and the relation and the distribution of these veins furnish a clue to the relationships of the different families. There are two reasons why little or no mention was made of the wing-veins in describing the *Lepidoptera*. In the first place the scales in most cases had to be removed, which would mean the destruction of possibly the only specimen of the kind the student had, and in the second place references to them would have led us too far afield into technical detail. In the *Diptera*, however, the wings are transparent and there are certain features of the cells of the wings that can be understood with little or no explanation. The cells of the wings are "closed," if no part of these cells touches any wing margin.

Syrphidae. These syrphus-flies (199) mimic bees, bumble-bees and wasps in appearance. There are six closed cells in each wing. One vein only ends in the hind margin of the wing.

Asilidae. The members of this family are known as robber-flies (200). They are usually large with long, slender, tapering abdomens. Closed cells five. The first long vein parallels the front margin.

Tipulidae. These are large mosquito-like flies known as crane-flies (201). The commonest species spread about 6 cm. Bodies, legs and wings long and slender. Closed cells, five.

Musidae. This is the great house-fly family. Usually with two closed cells and a very large cell nearly closed at the wing-tip.

The following resemble the house-fly in appearance:

The stable-fly (202) is grayish with four black stripes on the chest.

The blow-fly (203) is somewhat larger than the house-fly. Black with a blue abdomen. Its larvae live on meat.

The horn-fly (204) is about half the size of the house-fly. A common pest of horned cattle.

The flesh-fly (205) has a whitish body marked with gray and black. This insect has the habits of the blow-fly.

The house-fly (206) is familiar enough to everybody. It breeds in horse manure.

Culicidae. These are the mosquitoes (207). Margin and veins of wings clothed with fringes of hair. The larvae (208) are the wrigglers found in more or less stagnant water. The active pupae (209) have a short, curved, heavy-set body and breathe through the "ear-flaps." The male mosquitoes have bushy antennae and do not bite. The antennae of the females are clothed with very short hair. Several genera common.

There is a family or two of small mosquito-like flies which are generally mistaken for the real mosquitoes. These insects are known as midges (210). The absence of hair from the margin and veins of the wings is their chief characteristic.

ORDER COLEOPTERA (Beetles)

Pupal or resting stage present, i. e., the metamorphosis is complete. The mouth-parts are formed for chewing. The outer wings generally hard and horny; the inner wings membranous.

Carabidae. This is the largest family of beetles and some of its members are very common. Collectively, they are known as ground beetles. Feet five-jointed. The bristle-shaped and tapering antennae are made up of eleven bead-like joints. Legs fitted for running. Head narrower than the thorax.

Harpalus caliginosus (211) is a very common black beetle 25 mm. long. *Pterosticus lucublandus* (212) is also a very common black beetle, 10 mm. long. In these two species the pronotum or plate before the wings is square and as wide as the body. The bombardier-beetle (213) has the head, prothorax and legs reddish-yellow. The outer wings are dark blue to black. Length, 10 mm.

Cicindelidae. The tiger beetles (214) are like the ground beetles in their antennae and feet but the head and thorax are about equal in width. A common species has a few oblique stripes on each fore wing cover.

The water beetles are divided into the three following families:

Dytiscidae. These are the so-called diving beetles (215). They are provided with thread-like antennae. The hind legs are very long and fitted for swimming.

Gyrinidae. The whirligig-beetles (216) are easily recognized. On many a pool of water these black forms disport and whirl around in colonies. Antennae short. Color blue-black. Length, 12 mm.

Hydrophilidae. The water-scavenger beetles have palpi as long as the antennae. The thickened ends of the antennae are formed by short lateral branches. The *Hydrophilus* (217) is a common specimen about 4 cm. long, shining, black, oval; convex above.

Silphidae. The carrion-beetles have a five-jointed fore foot and a four-jointed hind foot. The last few segments of the antennae are thickened into a solid club. A common species belonging to the genus *Necrophorus* (218) has two broad, reddish spots or cross bands on each wing. This beetle is 20 mm. long and is cylindrical.

Silpha (219) is another common specimen. Its wings are leathery. Body flat and broad. The soft shield covering the front part of the body is rounded, yellow with a black centre.

Staphylinidae. The members of this family called rove-beetles have long and slender bodies and short wings. A common species (220), is colored metallic yellow on the under side of the thorax and when molested it raises its rear end as though it would sting. It is 20 mm. long and four mm. wide. Color a dingy gray.

Coccinellidae. These are the lady-bugs (221). Body nearly hemispherical, red or yellow with black dots. Small. Feet of three joints. The lady-bugs are very valuable.

Elateridae. On each side of the thorax there are two backward projecting spines which enable these "snapping bugs" to "click." Hind feet five-jointed. Many species (222) are brown. The eyed elater (223), *Alaus oculatus*, is black; outer wing spotted with small dots. On the thorax there are two round, jet-black and velvety eye-spots. Length, 30 mm. The wire worms (224), those stiff, cylindrical brown grubs, are the larvae of the click-beetles or snapping bugs.

Lampyridae. This is the firefly family. The antennae are saw-like and eleven-jointed. Wings soft; some of the females are wingless and are known as glow worms. Hind feet five-jointed. The common firefly (225) is very familiar. On the golden rod during fall one often finds the soldier beetles. The Pennsylvania soldier-beetle (226) is yellow with dark spots on the chest and on the back part of each wing cover. The margined soldier-beetle (227) has an orange head.

Lucanidae. The stag-beetles (228) live on tree trunks. Feet of five joints. The terminal enlargement of the antennae is made possible by the presence of leaf-like appendages on one side, which arise from different points and which can not therefore be brought closely together. The antennae are elbowed. They are called stag-beetles on account of the large jaws possessed by the males of certain species.

Many common forms, too, have a conspicuously narrow waist connecting the chest with the body.

Scarabaeidae. This is the June-bug family. The members of it resemble the stag-beetles in structure of feet and antennae, but the leaves of the antennae are flatter and seem to arise from one point, so that they can be folded together tightly into a closed knob. Frequently, too, the legs are very spiny. The tumble bugs and dung beetles belong here; the former (229) are mostly black with a shield that completely covers the head; the latter (230) are blue-black with brilliant reflections; wings finely ribbed. Both have very spiny legs. The mahogany-brown June-bugs (231) which fly and tumble around our lights during June are familiar enough.

The rose-bug (232), *Macrodactylus subspinosus*, which is densely clothed with fine yellow hair and provided with very long legs, is certainly familiar to cultivators of roses. Length, 10 mm. The spotted Pelidnota (233) is reddish-brown and on each wing there are three dots. Length, 20 mm.

Cerambycidae. Feet apparently four-jointed. The antennae are long and tapering, the second segment is very short. The shield over the thorax in one group of this large family is edged with spines. Buck-beetles is the general term for the members of this family. The commonest buck-beetle is a red insect found on the milkweed, the *Tetraopes tetraophthalmus* (234). In this species there are four black spots on each wing and four on the chest. Length, 12 mm. The cloaked knotty-horn is 25 mm. long, of a metallic blue color, and is banded by orange-yellow at the base of the wings.

The straight-bodied prionid (235) is 40 mm. long and 10 mm. wide. Its wings are light brown, and there are three spines on the edge of the rounded thorax-cover.

The broad-necked Prionus (236) is black in color.

Three prominent spines on each edge of the thorax. Length, 40 mm.

Chrysomelidae. The Colorado potato-beetle (237) is a good type of these leaf-eaters, although about the largest. Their bodies are usually short, hemispherical, and are flat below. Feet apparently four-jointed. Legs and thorax short. Many species common.

Meloidae. There is one species of this family, namely the blister-beetle (238), *Epicauta cinerea*, that is very frequently seen as it feeds on the pollen of the golden rod Black. Length, 12 mm. Outer wings soft. Head much wider than the neck. Four joints in hind feet.

Curculionidae. The weevils are at once distinguished from the other *Coleoptera* by the presence of a long snout. In economic zoology the plum weevil (239) is usually treated at some length. The larva of this weevil is the well-known grub or worm of wormy cherries. The mature weevil is yellowish brown and faintly spotted.

ORDER HYMENOPTERA (Bees, Wasps, Ants and Allies)

Pupal or resting stage present, i. e., the metamorphosis is complete. The wings are transparent and the hind ones are the smaller. Mouth-parts formed for sucking and chewing. The larger members of this order can ordinarily be separated by beginners, but the use of a hand lens may be necessary. The families may be divided into two great divisions on the basis of a one or two segmented-trochanter of the hind leg. In order to determine which is the trochanter, it might be well to look first for the two long segments that make up the middle of the leg; the outer segment is the tibia, the inner the femur. Next to this femur, or the second segment from the body, is the trochanter.

The two super-families known as the *Sphecina* and the *Vespina* have the following characters in common:

The trochanter of each hind leg consists of one segment; the sting when present arises from the tip of the abdomen; the fore wing has at least one closed sub-marginal cell; the hind tarsi are slender, not flattened and there is an absence of a knot on the first segment of the abdomen.

The sub-marginal cells are those which are separated from the front margin by the marginal cells. The sub-marginal cells may be close to but they do not touch the front margin.

Sphecina. The *Sphecina* group includes the so-called digger or solitary wasps. Their wings are not folded when at rest; the pronotum, that is the collar back of the neck, does not extend, in those species apt to be collected here, to the base of the fore wings. Most of them are thread-waisted and make mud-nests which are fastened to rafters, etc.

The cicada-killer (240) is a very heavy bodied wasp about 40 mm. long. It has three yellow broken bands on the abdomen.

The mud-daubers (241) or thread-waisted wasps are remarkable for the extreme thinness of the first part or petiole of the abdomen. These are commonly seen making or repairing their mud-nests.

Vespina. The *Vespina* includes the true or social wasps, although not all the members of the *Vespina* group are social. They fold their wings in plaits when at rest. and their collar extends laterally to the base of the fore wing.

Eumenidae. The members of this family have only one spine on the outer end of each tibia. In the potter-wasp (242) the upper part of the first segment of the abdomen is bell-shaped; yellow rings mark the limits of the black segments. The members of this family are solitary in their habits. Some of them make their nests in the pith of plants.

Vespidæ. These are the real social wasps. The queens are the largest, the males have seven segments in the abdomen while the undeveloped females or workers have only six. Tibiæ of middle legs armed distally with two spurs. They make two types of nests, the open and the closed. The *Polistes* (243), whose segments are either black ringed with yellow or are brownish ringed with black, make the open nests. These nests are familiar objects in barns and abandoned garrets. They always consist of a number of inverted cells arranged side by side so as to form a rough circle which is supported by a slender stalk. The *Vespa* make the closed nests. Those frequently seen on trees are made by the hornet wasps (244) and those constructed under stones or logs are made by the yellow-jacket wasps (245).

Apina. The *Apina* group to which the honey bee (246) belongs is at once distinguished from all other hymenopterous forms by the abundance of hair clothing the body and by the flattened tarsi of the hind legs which are usually margined with long hair.

The leaf-cutting bees (247) cut out, as though one used a shears, parts of rose leaves.

The carpenter-bees (248) make their cells in the elderberry and other stems.

The appearance and work of the bumble-bee (249) and the honey bee are well known and are fully treated in many books.

Formicina. This group includes the ants and the members are characterized by the presence of an enlargement between the body and the abdomen proper. Unlike most of the insects belonging to this order, they lack the tegula or cup-shaped scale which partly covers the base of the fore wings.

The large black ant (250); the mound-building ant (251), whose head and thorax are dusky red; the slave-

maker ant (252), which resembles the preceding one in appearance; the slave ant (253) which is dark-brown with reddish legs; the brown ant (254) and the very common red ant (255), are all apt to be seen.

Pelecinidae. This family is represented by a single species and of this the female alone is usually caught. In the fore wings there are no closed sub-marginal cells. The color of the female (256) is black. Its abdomen is about six times the length of the thorax. Found feeding on plants in woodlands during the latter part of summer.

All the hymenopterous insects so far described have a one-segmented trochanter of the hind leg; the following ones have a two-segmented trochanter of the hind leg:

Saw-flies. In this family the abdomen is widely joined to the rest of the body. The tibia of the fore leg is provided with two spines at the outer end.

The larvae (257) of the American saw-fly, *Cimbex americana*, are common during the fall. We generally find them on the willow. It is yellowish-white with a black stripe down the back. The adult (258) is very large and heavy; its legs are unwieldy; color dark-brown and usually with a yellow spot on the first segment of the abdomen. The little green larva with a black head, called the currant worm (259), is a saw-fly.

Siricidae. The large horn-tail (260) resembles in general appearance the American saw-fly. The female horn-tail, however, is provided with three large needles used for boring while the female saw-fly is equipped with a pair of saws. Then again at the distal end of front tibia the horn-tail has only one spine.

Cynipidae. These are the gall-flies and their work is recognized by the galls (261) or globular growths which are the little palaces made by the mother gall-fly for her children. The oak-leaf galls are very common.

Ichneumonidae. The ichneumon flies are very important since their members form the great body of beneficial, parasitic insects. The fact that the trochanter is two-jointed must not be overlooked in determining them. The piercing apparatus, if present, leaves the body a little before the tip of the abdomen. The outer half of the fore wings contains one or two closed cells. If only one it is located as near or nearer the rear as the fore margin of the wing; if two cells are present, one wall is common and the anterior one is the smaller. A cell is "closed" if it does not touch the margin of the wing.

One of the most remarkable insects we have is the *Thalessa*. The female *Thalessa atrata* (262) which is black with a yellow head is fully two dm. long from the tip of the antenna to the tip of the ovopositor. The female *Thalessa lunator* (263) is somewhat smaller and has a light brown color, with brownish spots on the wings and yellow rings around the abdomen.

The *Ophion* (264) is a common ichneumon fly. This insect is pale yellow all over. It spreads about 40 mm.

Other forms (265) are jet-black with a swelling on one of the slender segments of the abdomen. There are many small species.

Braconidae. The *Braconids* are the best known from the habits of the little *Microgaster* (266), whose barrel-shaped cocoons, a few mm. in length, are occasionally seen hanging fast to the back of some caterpillar, for example, one of the hawk-moths. Structurally and in habits they resemble the members of the preceding family and by some entomologists they are included in it.

SUBKINGDOM VERTEBRATA

CLASS I PISCES (Fishes)

In order to separate the common families of fish, the names and locations of the different fins should be fixed. The dorsal fin is the one on the back—in certain families there is more than one dorsal fin, the caudal is the tail fin, the anal is right back of the vent, the pectorals are the two nearest the gill-openings, and the ventrals are the only paired fins on the lower side of the body.

In some families the ventrals are nearly as far front as the pectorals, then the ventrals are called the jugulars, or thoracics; in other families they have migrated backward and when they arise just before the vent these ventrals are known as the abdominals or the abdominal fins.

There are a number of very interesting forms structurally related to the true fishes which are usually placed immediately below them. Excepting the lamprey eel, none of these specimens has been caught in our waters. The lamprey, too, as far as our present knowledge of the distribution of these forms goes, has not been found either in the Lehigh or Schuylkill or in any of their tributaries. It abounds, however, in the Delaware and the Susquehanna rivers. Thoreau says that in the spring the lamprey ascends small brooks for the purpose of depositing its spawn. They are then often found clinging to stones and clods of earth. Later in the season they disappear, and are seldom seen except when attached to some unlucky fish. They are rarely seen descending the stream and "it is thought by fishermen that they never return, but waste away and die clinging to rocks and stumps of trees for an indefinite period; a tragic feature in the scenery of the river bottoms worthy to be remembered with Shakespeare's description of the sea floor."

The following artificial key will generally enable the student to trace his specimen to its proper family:

- a. Ventral fins abdominal.
 - b. Dorsal fins 2, the first rayed, the second without rays.
 - c. Body not scaly. *Silurids.*
 - cc. Body scaly. *Salmonids.*
 - bb. Dorsal fin single, of soft rays only.
 - c. Head more or less scaly.
 - d. Snout prolonged; lateral line present. *Esocids.*
 - dd. Snout not prolonged; lateral line absent. *Cyprinodontids.*
 - cc. Head not scaly.
 - d. Dorsal fin with less than 10 rays. *Cyprinids.*
 - dd. Dorsal fin with more than 10 rays. *Catostomids.*
 - aa. Ventral fins thoracic or jugular.
 - b. Dorsal fins 2, continuous. *Centrarchids.*
 - bb. Dorsal fins 2, not continuous. *Percids.*
 - aaa. Ventral fins wanting. *Anguillids.*

Siluridae. The members of this family are known as catfishes. The first dorsal fin contains a strong spine. In the common bullhead or horned pout (267), *Ameiurus nebulosus*, the second or posterior dorsal is free behind. On the upper jaw there are two barbels. Very large, brownish, yellowish, or black.

The stone cat (268), *Noturns insignis*, is always small. On the upper jaw there are four barbels. Head flat. Second or posterior dorsal in the form of a keel. Reddish-brown.

Salmonidae. This is the trout family. "This is the last generation of trout fishers. The children will not be able to find any. Already there are well-trodden paths by

every stream in Maine, in New York, and in Michigan. I know of but one river by the side of which you will find no paper collar or other evidence of civilization. It is the Nameless River. Not that trout will cease to be. They will be hatched by machinery, and raised in ponds and fattened on chopped liver, and grow flabby, and lose their spots. The trout of the restaurant will not cease to be. He is no more like the trout of the wild river than the fat and songless reed-bird is like the bobolink. Gross feeding and an easy life enervates and depraves him. The trout our children will know only by legend is the gold-sprinkled living arrow of the White-water, able to zig-zag up a cataract, able to loiter in the rapids, whose dainty meat is the glancing butterfly."

This is the pessimistic view of a devoted disciple of Izaak Walton. The anglers are many who hope that this prophecy will prove untrue.

The speckled trout (269) is black on the back, marbled with golden yellow. The sides are golden mottled with grayish-brown and marked with rounded, golden-yellow and red spots.

The rainbow trout (270) has very small scales and orange-colored spots.

The brown trout (271) is distinguished from the others by its prevailing brown color.

Esocidae. The members of the pike family have an elongated body and a large mouth.

Two kinds of pikes caught here are the pickerel or pond pike (272), *Esox americana*, and the chain pickerel or federal pike (273), *Esox reticulatus*. The former is more or less golden, crossed by dusky blackish bars; for a pike the snout is rather short. The latter is marked with a net-work of horizontal blackish streaks, and has a long up-curved snout. The lateral line, to which reference has already been made, extends longitudinally down the sides of

these and other fishes. It appears on the scales not unlike a pin-scratch.

Cyprinodontidae. The killifishes are always small and carnivorous. They are, no doubt, called "killifishes" because they seem to have the "killing instinct" highly developed. The fresh-water killifish (274), *Fundulus diaphanus*, has a flattish head and silvery sides which are crossed by a number of dark bands.

Cyprinidae. The minnows commonly called "minnies" belong to this family. As a rule, they are small. No scales on the head; gill-coverings fastened to the breast, i. e., they are not free. During spring, in the males, the snout and other portions of the body are covered with small tubercles. In this sex, also, the fins are then more or less conspicuously colored with red, yellow or black. The young of both sexes can be distinguished by their large eyes and frequently by a black stripe on the side which may disappear later. Fins and scales of the members of this family are often black-spotted, the work of parasitic fungi. These spots are especially prominent on the minnows which live in sluggish streams.

The black-nosed minnow (275), *Rhinichthys atronasmus*, has a permanent black band on the side, which, on a level with the eyes, continues around the snout. In the spring this band, in the males, is crimson changing to orange in the summer.

The common shiner, dace or red-fin (276), *Notropis megalops*, should be determined by dissecting out its throat teeth. Any boy with a good knife and a little patience should be able to find two small bones encircling the front part of the throat. Each of these bones is provided with a double row of teeth. The larger teeth, four in number, form one row; the smaller teeth, two in number, form the other row. Then, too, if the scales are counted from the front part of the dorsal fin directly to the scratch-like lat-

eral line, they will be found to be six in number; between the vent or back opening of the alimentary canal and this lateral line, they are three in number.

The golden shiner (277), *Notemigonus chrysoleucus*, has ten throat or pharynx teeth, five in one row, on each side bone; they are serrate on one edge and of unequal size. Between the tail fin and vent there is a sharp, compressed edge of skin which is not crossed by scales. From the dorsal fin to the lateral line there are ten scales, and from the vent to this line there are three scales. The body is more or less compressed laterally, and the high back joins the low head in a curved line. Lateral line much decurved; fins yellowish; sides golden. May reach 2 dm. in length.

The chub (280), *Scmutilus atromaculatus*, is a rather big-headed fish; back, dusky brown; a dark blotch at the base of dorsal fin which is preceded by 30 scales.

To the fore-going members of this family should be added the imported carp. The German carp (281) has a long dorsal fin which is preceded by a strong spine; four barbels are present at the mouth. In domestication, the leather carp (282), a variety of the former, has been developed. The leather carps have very large irregular scales on the back and ventral parts.

A few more small individuals (283), native to our waters, might also be added.

Catostomidae. The mouths of suckers are provided with thick, fleshy lips.

The common sucker (284), *Catostomus teres*, has thick lips covered with papillae; scales small; back low.

In the chub sucker (285), *Erimysson sucetta*, the scales are large and have a greater vertical than longitudinal diameter; yellowish below; back high; upper lip rather thin.

The common sun-fish or "sunny" (286), *Lcpomis gibbosus*, has a faint dark spot on the short flaps which are,

in this case, only short backward extensions of the horny gill coverings; sides bluish, mottled with orange.

The long-eared sun-fish (287), *Lepomis auritus*, has a long, broad, black flap, likewise an extension of the gill covering on each shoulder; bluish stripes on the head.

Percidae. The commonest members of this family are the darters. The skin covering the gills is not attached to the breast; at least one stiff spine in the anal fin. Small.

The "Johnny" (288), *Etheostoma nigrum*, is, or a variety of it is, probably our most common darter; snout decurved; mouth small and somewhat inferior; back low; nine spines in front dorsal; sides irregularly blotched with a dusky color.

Anguillidae. In many respects the common eel (289) differs from our other fishes; brown; snake-like.

CLASS II AMPHIBIA (Frogs and Allies)

The Amphibians are divided into two orders: those with a tail throughout life—the *Urodella*, and those whose tail disappears with age—the *Anura*.

ORDER URODELLA (Salamanders)

Plethodontidae. Those salamanders with cylindrical tails are seldom found in water.

Red-backed Salamander (290). *Plethodon cinereus*. Generally with a broad brownish-red band on the dorsal side; under side finely mottled with white and gray; tail cylindric; found under logs, etc.

Stout Salamander (291). *Plethodon glutinosus*. Shining back with grayish spots; a white band on throat; tail cylindric.

The striped salamander (292), *Spelerpes bilineatus*, is light yellow with a black line on each side extending backward from the eye.

Cave Salamander (293). *Spelerpes longicauda*. Orange-yellow; sides and back with many black spots; black-barred on very long tail.

Red Salamander (294). *Spelerpes ruber*. Stout; dark red, or reddish-yellow in formaldehyde; many dark spots on side and back.

Pleurodelidae. Only one species belongs to this family. Newt. *Diemictylus viridescens*. When immature (295)—the stage most frequently seen—the upper parts olive-green or reddish with a row, on each side, of scarlet spots which are encircled by black. When mature (296), it becomes bright orange-red all over, except at the spots; the tail fin disappears and after egg-laying time in spring it is not found in water.

ORDER ANURA (Frogs and Toads)

Bufonidae. The common toad (297) is toothless; two black spots below the eyes; adults warty. Eggs in gelatinous strings laid in water during early spring.

Hylidae. The members of this family are fitted with enlarged and sticky toe-tips in order to hang fast to trees. Their general name is tree frogs.

Cricket Frog (298). *Acris gryllus*. Back brown with three black spots edged with whitish. Length, 35 mm.

Common Tree Toad (298). *Hyla versicolor*. This specimen possesses the ability of changing its color more or less in harmony with the back-ground. It may be greenish, grayish or brownish with blotches. Length, 5 cm.

Pickering's Tree Frog (299). *Hyla pickeringii*. Grayish-brown; a large X on the back made by dusky lines. Length, 25 mm.

Ranidae. Teeth present on the upper jaw. Eggs laid in water, enclosed in a gelatinous mass.

Leopard Frog (300). *Rana pipiens*. Green with large, irregularly rounded, black spots edged with whitish. On the hind legs the spots are in the form of bars.

Pickerel Frog (301). *Rana palustris*. Light brown with two rows of dark brown blotches down the back. Hind legs yellowish below.

Wood Frog (302). *Rana sylvatica*. Reddish-brown; a broad, dark brown band along the side of the head, margined below by a whitish line. Hind legs long, lightly barred above.

Green Frog (303). *Rana clamitans*. Ear-drum about the size of the eye. At the edge of the back, on each side, there is a puckering fold of skin, extending from the eye to near the hind leg. Green or brownish; green in front; yellowish or whitish below. Small, dark blotches above toward the rear; these blotches become bars on the hind legs. Length, 7 cm.

Bull-frog (304). *Rana catesbeana*. This and the preceding specimen are the only frogs whose tympana or ear-drums are as large or larger than the eyes. These ear-drums are located right back of the eyes. The lateral fold of the skin, which is usually prominent among frogs, is absent in the bull-frog. A short fold, however, bending from the eye above the ear-drum toward the front leg, is present. Head bright green. Faint dark spots on the greenish back. Length, when mature, 2 dm.

CLASS III REPTILES (Snakes and Allies)

The reptiles in our range are generally divided into three groups or orders.

1. Ophidia. Legs absent; scaly.
2. Lacertilia. Legs present; scaly.
3. Testudinata. Legs present; body more or less enclosed in a bony or leathery box which is formed of large plates.

ORDER OPHIDIA (Snakes)

The following is a key to the genera of snakes so far reported in this range. The analysis applies principally to the species here described. A word of explanation concerning certain terms used may not here be amiss.

Scales are "keeled," if there is a small longitudinal ridge crossing them. The anal plate is the one next before the vent or posterior opening of the alimentary canal. This plate in certain families is "bifed," i. e., cut obliquely into two indistinct parts. The "rows of scales" are those counted oblique-wise around the middle of the body.

Just a few words more might be said here before the study of snakes is taken up. In spite of statements to the contrary, these animals, whether beneficial or not, have very, very few friends. A stone or club is the first thing practically everybody thinks about if a "snake is seen." It is too much to expect that a course in zoology can entirely remove, in most cases, this groundless fear. But it has occurred to us that inasmuch as everybody is liable to meet a snake, a little proper instruction concerning them should decrease the hysterical fear which their presence arouses. A man dominated by reason will always try to distinguish his friends from his real foes.

- a. No pit between eye and nostril; head more or less elongated; body generally slender; fangs absent; *non-venomous*. (*Colubrids*.)
- b. Dorsal scales keeled.
 - c. Anal plate entire.
 - d. Scales in 19 rows. *Thamnophis*.
 - cc. Anal plate bifid.
 - d. Scales in 15 rows. *Storeria*.
 - dd. Scales in 19—25 rows.
 - e. Snout keeled. *Heterodon*.
 - ee. Snout not keeled.
 - f. Scales in 19 rows. *Regina*.
 - ff. Scales in 23 rows. *Natrix*.
 - bb. Dorsal scales smooth.
 - c. Anal plate entire.
 - d. Scales in 21 rows. *Lampropeltis*.
 - cc. Anal plate bifid.
 - d. Scales in 15 rows; no yellow ring. *Liopeltis*.
 - dd. Scales in 15 rows; yellow ring. *Diadophis*.
 - ddd. Scales in 17 rows. *Bascanion*.
- aa. Pit between eye and nostril; head more or less triangular; neck constricted; erectile poison fangs present, but ordinarily concealed in pockets on upper jaw; *venomous*. (*Crotalids*.)
 - b. Tail without rattle. *Agkistrodon*.
 - bb. Tail with rattle. *Crotalus*.

Colubridae. Riband Snake (305). *Thamnophis sauritus*. Light with three yellow stripes; abdomen greenish-white. The lateral stripes are on the third and fourth rows of scales. Body slender.

Common Garter Snake (306). *Thamnophis sirtalis* var. In the collection, judging from color-variations, there seems to be several varieties of this species. The variety most frequently collected here has several series of short, white, narrow, horizontal marks between the scales on the sides;

there are about two series of square black blotches on each side of the body; a narrow light stripe extends down the middle of the back.

Red-bellied Snake (307). *Storeria occipitomaculata*. This specimen does not exceed 3 dm. in length. It is chestnut-brown on the back and salmon-pink below. There are three pale spots right back of the head.

Spreading Adder, Blowing Viper (308). *Heterodon platirhinus*. Body short and stout; yellowish above, greenish-yellow beneath; about 28 dark dorsal blotches. When angry this snake expands its neck and "hisses." Although not generally thought so, it is quite harmless.

Queen Snake (309). *Regina leberis*. Light brown above; three dark bands extend down the body, one median and the other two lateral. Under parts yellowish and striped with four dark brown bands—two median and the other two lateral.

Water Snake (310). *Natrix sipedon*. Brownish above with a number of more or less distinct, irregular, cross or oblique, whitish bars edged with black. Blotched or mottled with reddish and black below and on sides.

Milk Snake (311). *Lampropeltis dolia* *triangulus*. This snake also has whitish cross-bars edged with black, but between these bars there is a series of large, rounded, reddish-brown blotches. A light arrow-shaped spot on the back of the head. Square black blotches on the lower parts.

Grass Snake (312). *Liopeltis vernalis*. Green. Below yellowish. This snake becomes bright blue in formalin. Small.

Ring-necked Snake (313). *Diadophis punctatus*. Black above and orange below; a narrow yellow ring around the neck. Small.

Black Snake, Blue Racer (314). *Bascanion constrictor*. Black above, greenish below; chin and throat white. The young are brownish gray with black blotches.

Crotalidae. Copperhead (315). *Agkistrodon contortrix*. A series of large chestnut-colored blotches extending over the back and widening on the sides; a series of lighter intermediate blotches. Under parts dull yellow with a series of large, dark blotches on each side. Top of head copper-colored, the front part of which is covered by nine large plates—the two rear plates have each a black spot. *Venomous*.

Rattle Snake (316). *Crotalus horridus*. Yellowish to brown above. Three series of dark blotches frequently running together, extending the length of the body. Below greenish-white to gray. The number of rattles, contrary to general belief, does not indicate the age of this snake. More than one may be produced in one season, or more than one may be lost in a single day. *Venomous*.

ORDER LACERTILIA (Lizards)

Iguanidae. Common Lizard, or Swift (317). *Sceloporus undulatus*. In this section the common lizard is the only representative of this family. It has toothed jaws, four well-developed legs and a brittle tail. When mature it attains a length of 2 dm. Scales on the back are strongly keeled and each ends posteriorly in a sharp point. Black, wavy, cross-bands extend over the back. Each leg ends in five long scaly digits. Not venomous.

ORDER TESTUDINATA (Turtles)

The body which covers the soft parts of turtles is really the modified bones of the trunk with the muscles on the inside. In human beings, as is well known, the muscles, etc., surround the bones. The back part of the skull is called carapace, and the breast part, the plastron.

Chelydridae. To this family belongs the snapping turtle (318), *Chelydra serpentina*. On the tail there is a crest

of thin bony prominences; posterior edge of the carapace with saw-like teeth, plastron covers only about one-third of the under parts; head large. In the spring the snapper lays some 60 to 70 eggs in the sand.

Kinosternidae. The stink-pot or musk turtle (319), *Aromochelys odoratus*, differs from the snapper in the absence of the bony crest on the tail and the saw-like teeth on the rear edge of the carapace. Odor musky.

Emydidae. The pond turtles, the general name for the members of this family, are without doubt the most common turtles we have, for they are apt to abound in every stream. As is generally the case with male turtles, the plastron of the males is slightly concave.

Painted Turtle (320). *Chrysemys picta*. Carapace low and smooth; plates margined with yellow; plastron yellow with blotches of brown; plates on the margin are marked with red.

Wood Tortoise (321). *Clemmys insculptus*. A prominent keel or ridge on the carapace, the plates of which are marked by radial and concentric lines; plastron yellowish with a black blotch on each plate.

Speckled Tortoise (322). *Clemmys guttatus*. Black with round orange spots on the carapace. Some of the plates of the plastron are marked with orange. Each plate shows lines parallel with one or more of its margins.

Common Box Turtle (323). *Terrapene carolina*. This clumsy land turtle, although a member of the pond turtle family, exhibits a marked variability in coloration. It is usually yellowish and blackish with spots and blotches of yellow; plastron hinged; carapace short and high. In the male the iris is red. Its flesh is said to be poisonous.

CLASS IV AVES (Birds)

No mention of the members of this class is made here. "A bird in the bush is worth two in the hand." To make a collection of birds or their eggs, except by acknowledged specialists, is as wrong in theory as it is vicious in practice. See "Field Study of Birds."

CLASS V MAMMALIA (Mammals)

In order to separate the orders and families of mammals, it is unfortunate, in a sense, to be obliged to depend in a measure on characters that are more or less hidden or that may require a little dissection to display them. Unlike the birds certain species of mammals lack distinctive external differences. It has been suggested that this is due to their general nocturnal habits and their need of a protective coloration. The structure of the organs of dentition and of locomotion seems to present the best clue to their relationships. Indeed, a series of skulls properly cleaned are not only agreeable to work with but are highly instructive. The teeth have the same names and arrangement as those in man.

The following is an analysis of the orders represented in our local fauna.

- a. Incisors large, two on each jaw; canines wanting, leaving a gap on each side of mouth between the incisors and molars. *Rodents.*
- aa. Incisors small, generally more than two; canines present; no gap on side of jaws.
 - b. Front legs fitted for flying. *Chiropters.*
 - bb. Front legs not fitted for flying.
 - c. Canines not prominent *Insectivors.*
 - cc. Canines prominent.
 - d. Tail naked. *Marsupials.*
 - dd. Tail covered with hair. *Carnivors.*

ORDER MARSUPIALIA (Marsupials)

The common opossum (323a), *Didelphis virginia*, is the sole representative of the marsupials. The female is provided with a pouch over the abdomen in which the newly-born young are carried. Grayish-white, with black-tipped white under fur; ears lengthy, black; feet black.

ORDER RODENTIA (Mice and Allies)

The members of this order are at once recognized by the presence of two large chisel-shaped teeth on each jaw in front; the remaining flat-topped teeth, molars, are in the rear of the mouth.

Leporidae. Cotton-tail. Gray Rabbit (324). *Lepus floridanus mallurus*. A pair of small vestigial incisors at base of the main upper pair. Brown above varied with cinnamon, russet and gray; below white with a brown band across back.

Zepodidae. Mouse-like; hind legs and tail much elongated. Meadow Jumping Mouse (325). *Zapus hudsonius*. Yellowish above mixed with many black-tipped hairs; white below including the tail. Length from nose to tip of tail, 2 dm. The laboratory specimen was caught by Prof. Gruber at Fox Hill during the middle of May, 1907.

Muridae. Hind pair of legs no longer than front pair; tail never longer than head and body. Tibia and fibula united below. The muskrat (326), *Fiber zibethicus*, is the largest member of this family; tail flattened and almost hairless; hind feet partly webbed; dark brown above, dull white below.

Meadow Mouse, Field Mouse, Meadow Vole (327). *Microtus pennsylvanicus*. Body thick and heavy; legs, ears and tail short; incisors broad; dark brown above, gray below. Length, 15 cm. This mouse does not enter barns during the winter.

Common White-footed Mouse, Deer Mouse, Wood Mouse (328). *Peromyscus leucopus*. Incisors narrow; eyes and ears large; yellowish-brown or fawn-colored above; under parts including tail and feet pure white; body slender. These mice nest beneath logs, etc.

The brown rat (329), *Mus decumanus*, the common house mouse (330), *Mus musculus*, belong to this family. Their abundance makes the most meagre description unnecessary. It seems strange that those very "undesirable citizens," the brown rat, the house mouse, the cabbage worm and the house sparrow should all be immigrants from the old world. Excepting the sparrow, all the other pests probably came here as a result of carelessness on the part of our ancestors.

Sciuridae. Tibia and fibula separate; tail more or less bushy. Most of the members of this family live on trees. The greater range of movements possible because of the separation of these bones and the presence of a rudder-like tail seem an excellent adaptation to an arboreal life which characterizes the majority of the squirrels.

Ground Hog, Woodchuck (331), *Arctomys monax*, is a marmot, not a squirrel, although it belongs to the squirrel family. Heavy-set and stocky; grizzly-gray to rusty-chestnut; feet black. Length, 6 dm.

Chipmunk, Ground Squirrel (332). *Tamias striatus*. Reddish-brown; five black strips and two of buff extending down the body; rump and hind legs reddish-chestnut; cheek-pouches present.

Red Squirrel (333). *Sciurus hudsonicus*. Yellowish gray with a sprinkling of rusty red on the upper parts; hairs of the tail banded with black and yellowish-red; a black stripe along each side of body in summer; white below.

Gray Squirrel (334). *Sciurus carolinensis*. Yellowish gray, rusty on face, feet and sides; below white; hairs of

tail white tipped. There are described both southern and northern red and gray squirrels. The forms here are the northern red and the southern gray.

Flying Squirrels (335). *Sciuropterus volans*. Sides with a furry membrane joining the fore and hind legs; yellowish-brown above, whitish below. When the legs are spread a sort of parachute is formed that enables them to glide obliquely downward from one point to another.

ORDER INSECTIVORA (Moles and Allies)

Two families are made of this order—the shrew family and the mole family. In the former the fore feet are similar to the hind feet, the snout is slender-pointed, and there is only a trace of an external ear. In the latter family the fore legs are fitted for digging, and there are no external ears and only vestigial eyes.

Soricidae. This is the shrew family, and the member (336) found can be determined by the description of the family.

Talpidae. Common Mole (337). *Scalops aquaticus*. Above dark leaden color, lighter below; tail short and naked.

Star-nosed Mole (338). *Condylura cristata*. Tail hairy and rather long. Blackish. A star-like appendage on the snout.

ORDER CHIROPTERA (Bats)

Fingers much elongated. An extensible skin connects the frame-work of the fore and hind limbs. That part of this skin which joins the first bones of the limbs on each side is known as the inter-femoral membrane.

Vespertilionidae. All of the bats belong to this one family. Several different kinds of bats are common. In

the little brown bat (339), *Myotis subulatus*, and the big brown bat (340), *Vesperugo fuscus*, this inter-femoral membrane is naked except at the base. The former is about 9 cm. long, while the latter is about 12 cm. long. In the red bat (341), *Lasiurus borealis*, this membrane is completely covered with fur on the upper side; fur reddish-brown; hairs mostly tipped with white; a white spot on each side in front.

ORDER CARNIVORA (Flesh-eaters)

Excepting the rodents these are the most abundant of our mammals. The very prominent canines and the more or less sharp molars fit them for their well-known, flesh-devouring habits. Specimens representing four families are found in this range; an analysis of these families follows:

a. Hind feet with five toes.

b. Large; tail bushy, ringed with buff and black.

Procyonids.

bb. Small or of medium size.

Mustelids.

aa. Hind feet with 4 toes.

b. Claws blunt, non-retractile; snout generally long.

Canids.

bb. Claws sharp, retractile; head short and round.

Felids.

Procyonidae. Common Raccoon (342). *Procyon lotor*. Stout; grayish-white; hairs black tipped; face whitish with a black mark on each cheek; feet black.

Mustelidae. Common Skunk, Polecat (343). *Mephitis mephitis*. Black and white; the amount and distribution of these colors are subject to much variation. Usually, however, there is a white patch on the back of the neck and two white stripes down the back. The protective odor of the skunk needs no description except possibly to state that the offensive secretion is entirely independent of the urinary system, contrary to general belief.

Mink (344). *Poturius vison*. Dark brown to black; a white spot on the chin; whitish below; tail bushy. Length, 5 dm.

New York Weasel (345). *Poturus noveboracensis*. Chocolate brown above, the end third of tail black. Excepting the end of the tail, this weasel becomes pure white in winter. Length, 4 dm.

Canidae. To this family belong the foxes and dogs. The fox (346), *Vulpes pennsylvanicus*, shows quite a marked variation in color. Two main varieties—the red fox and the gray fox—are usually described. Of the red fox there is a black, silver and cross phase. The hairs of the gray fox are banded black and white; tips of each ear black; dark on the back.

Felidae. Cats, panthers, lions, etc., belong here. Wild Cat, Bob Cat, Catamount (347). *Lynx rufus*. Yellowish-brown; below white spotted with black; inner sides of legs with dark cross-bands; blackish stripe down the back; tail short. Found chiefly on the mountains. Length, 1 m.

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INDEX

- Acanthiidae, 27
- Acridids, 21
- Acrosoma, 18
- Aeschnids, 19
- Agalena nevia, 17
- Agapetidae, 43
- Agrionids, 19
- American Copper, 44
- Amphibians, 61
- Amphipods, 15, 16
- Angle Wings, 41
- Angoumois grain-moth, 34
- Anguillidae, 60
- Ant-lions, 28
- Ants, 52
- Anura, 61, 62
- Aphididae, 24
- Apina, 52
- Arachnids, 17
- Arctiidae, 33
- Argiopa riparia, 18
- Argiopa transversa, 18
- Arthropoda, 15
- Asilidae, 45
- Atlanticus, 22
- Aves, 69

- Back-swimmers, 25
- Banded Purple, 42
- Bats, 72
- Bed-bugs, 27
- Beetles, 46
- Bella-moth, 33
- Belostoma Americanum, 26
- Birds, 69
- Bivalves, 14
- Black-nosed Minnow, 58
- Black Snake, 66
- Black Swallow-tail, 37
- Blattids, 21
- Blood-suckers, 14
- Blow-fly, 46
- Blowing Viper, 66
- Blue-eyed Grayling, 43
- Blue Racer, 66
- Blues, 44

- Blue Swallow-tail, 38
- Bob Cat, 74
- Bombardier-beetle, 47
- Box Turtle, 68
- Brachonidae, 54
- Broad-necked Prionus, 49
- Buck-beetles, 49
- Buckeye, 42
- Bufonidae, 62
- Bull-frog, 63
- Bumble-bees, 52
- Butterflies, 29

- Cabbage Butterfly, 39
- Calopterygids, 19
- Calopteryx maculata, 19
- Canidae, 74
- Carabidae, 46
- Carnivora, 73
- Carpenter-bees, 52
- Carps, 59
- Carrion beetles, 47
- Catamount, 74
- Catocalas, 32
- Catostomidae, 59
- Cave Salamander, 61
- Cecropia Moth, 31
- Centipeds, 16
- Cerambycidae, 49
- Cercopidae, 24
- Chain-dotted Geometer, 32
- Chauliodes, 28
- Checkered-white Butterfly, 39
- Chelydridae, 17
- Chipmunk, 71
- Chiroptera, 72
- Chub, 59
- Chrysomelidae, 50
- Chrysopidae, 28
- Cicada-killer, 51
- Cicadas, 23
- Cicindelidae, 47
- Clear-winged moths, 35
- Clepsine, 14
- Cloaked Knotty-horn, 49
- Clothes Moths, 34

Cob-web Weavers, 17
 Coccidae, 24
 Coccinellidae, 48
 Cock-roaches, 23
 Codling-moth, 35
 Coelenterata, 13
 Coleoptera 46
 Colorado Potato Beetle, 50
 Colubridae, 65
 Common Bullhead, 56
 Conocephalus, 22
 Copperhead, 67
 Coppers, 44
 Coreidae, 20
 Corsidae, 25
 Cosmopolite, 41
 Cotton Tail, 70
 Crab Spiders, 17
 Crane-flies, 45
 Crayfish, 15
 Crescent-spots, 41
 Crotalidae, 67
 Crustacea, 15
 Culicidae, 46
 Curculionidae, 50
 Cyanid Jar, 6
 Cyprinidae, 58
 Cyprinodontidae, 58
 Cyrtophyllus, 22

Dace, 58
 Daddy Long Legs, 18
 Damsel Bugs, 27
 Darters, 60
 Datana ministra, 35
 Decapods, 15
 Deer Mouse, 61
 Diptera, 44
 Diving Beetles, 57
 Dobson, 28
 Dragon-flies, 19
 Dytiscidae, 47

Earthworms, 14
 Eel, 60
 Elateridae, 48
 Emesidae, 26
 Emperors, 43
 Emydidae, 68
 Epeira, 18
 Ephemerida, 18
 Epiaeschna, 20
 Esocidae, 57
 Eucleidae, 36

Eumenidae, 51
 European Fruit Scale, 25
 Eyprepia Tiger-moth, 34

Fall Web-worm, 34
 Felidae, 74
 Field Mouse, 70
 Fire-flies, 48
 Fishes, 55
 Fish-moth, 18
 Flesh-fly, 46
 Flies, 44
 Formicina, 52
 Foxes, 74
 Fresh-water Clam, 14
 Fresh-water Shrimp, 16
 Fritillaries, 40
 Frogs, 61, 62
 Funnel-web Weavers, 17

Gall-flies, 53
 Garden Slug, 15
 Garter Snake, 65
 General Key, 10
 Geometrinæ, 32
 Geophilids, 16
 Giant Slug, 15
 Giant Swallow-tail, 38
 Grasshoppers, 20
 Grass Snake, 66
 Gray Leech, 14
 Gray Rabbit, 70
 Great Spangled Fritillary, 40
 Green-clouded Swallow-tail, 37
 Green Frog, 62
 Ground Beetles, 46
 Ground Hog, 71
 Gryinidae, 47
 Gryllids, 21

Hair-streaks, 44
 Helix, 14
 Hellgrammite, 28
 Hemiptera, 23
 Hesperidae, 36
 Heterina americana, 19
 Heteroptera, 23, 25
 Hexapoda, 18
 Homoptera, 25
 Hop Merchant, 42
 Hornet, 52
 Horn-fly, 46
 Horn-tail, 52
 House-fly, 46

- Hydra, 13
 Hydrobatidae, 26
 Hydrophilidae, 47
 Hymenoptera, 50

 Ichneumonidae, 54
 Iguanidae, 67
 Imperial Moth, 29
 Insecta, 18
 Insectivora, 72
 Io Moth, 30
 Isabella Tiger-moth, 34
 Isopods, 15

 Jassidae, 24
 Julids, 16
 June-bugs, 49

 Katydid, 21
 Killifishes, 58
 Killing, 16
 Kinosternidae, 68
 Kissings Bugs, 26

 Lace Bugs, 26
 Lacertilia, 64, 67
 Lace-winged flies, 28
 Lady-bugs, 48
 Lampyridae, 48
 Lasiocampidae, 36
 Leaf-cutting Bees, 52
 Leaf Hoppers, 24
 Leaf-rollers, 35
 Lecanium Scale, 25
 Leeches, 14
 Leopard Frog, 62
 Lepidoptera, 28
 Leporidae, 70
 Libellula pulchella, 20
 Libellulids, 20
 Lice, 27
 Limnea, 14
 Lithobiids, 16
 Little Red Leech, 14
 Little Wood Satyr, 43
 Lizard, 67
 Locusts, 21, 23
 Locustids, 21
 Loopers, 32
 Lucanidae, 48
 Luna Moth, 30
 Lycanidae, 44
 Lymantriidae, 36
 Lymnadidae, 43

 Mammalia, 69
 Margined Soldier Beetle, 48
 Marsupialia, 70
 May flies, 18
 Meadow Fritillary, 41
 Meadow Grasshopper, 21
 Meadow Jumping Mouse, 70
 Meadow Mouse, 70
 Meadow Vole, 70
 Meloidae, 50
 Membracidae, 24
 Methods of Mounting, 7
 Mice, 70
 Microcentum, 22
 Microgaster, 54
 Midges, 46
 Milk Snake, 66
 Milkweed Butterfly, 43
 Millipeds, 16
 Mink, 74
 Minnows, 58
 Mole Crickets, 22
 Moles, 72
 Mollusca, 14
 Monarch, 43
 Mosquitos, 46
 Moths, 28
 Mourning Cloak, 41
 Mouse, 71
 Mud-daubers, 51
 Muridae, 70
 Muscidae, 45
 Mussels, 14
 Mustelidae, 73
 Myriapoda, 16
 Myrmeleonidae, 28

 Nabidae, 27
 Nepidae, 25
 Nets, 7
 Neuroptera, 27
 Newt, 61
 Noctuidae, 31
 Notched-winged Geometer, 32
 Notodontidae, 35
 Notonectidae, 25
 Nymphalidae, 40

 Odonata, 19
 Ophidia, 64
 Ophion, 54
 Opossum, 70
 Orb Weavers, 18
 Orthoptera, 20

Owlets, 32
Oyster-shell Scale, 24

Painted Beauty, 41
Painted Turtle, 68
Pandorus Sphinx, 33
Papilionidae, 37
Parasitica, 23, 27
Peach-tree Borer, 35
Pearl crescent, 41
Pelecniidae, 53
Pennsylvania Soldier Beetle, 48
Pentatomidae, 27
Percidae, 60
Phasmids, 21
Physa, 14
Pickerel Frog, 62
Pickering's Tree Frog, 62
Pieridae, 39
Pikes, 57
Pill-bugs, 15
Pisces, 55
Planorbis, 14
Plant Lice, 24
Plathemis lydia, 20
Pleurodelidae, 61
Polecat, 73
Polistes, 52
Polydesmids, 16
Polyphemus Moth, 30
Porifera, 13
Potter-wasp, 51
Procyonidae, 73
Promethea Moth, 30
Putnam's Scale, 25

Queen Snake, 66

Raccoon, 26
Ranidae, 62
Rat, 71
Rattle Snake, 67
Red Admiral, 41
Red-backed Salamander, 61
Red-bellied Snake, 66
Red-fin, 58
Red-legged Locust, 21
Red Salamander, 61
Red-spotted Purple, 42
Reduviidae, 26
Regal Fritillary, 40
Regal Moth, 29
Reptiles, 64
Riband Snake, 65

Ring-necked Snake, 66
Roadside Butterfly, 39
Robber Flies, 45
Rodentia, 70
Rose-bug, 49
Rove-beetles, 48
Royal Moths, 29
Running Spiders, 17

Salamanders, 61
Salmonidae, 56
Salt-marsh Caterpillars, 34
San Jose Scale, 24
Saturnians, 29, 36
Saw-flies, 53
Scarabaeidae, 49
Sciuridae, 71
Scolopendrids, 16, (Tropical)
Scudderia, 22
Scurfy Scale, 35
Scutigerids, 16
Sesiidae, 35
Shield-backed Grasshoppers, 22
Shiners, 58
Sialidae, 28
Silpha, 47
Silphidae, 47
Siluridae, 56
Silver-bordered Fritillary, 40
Silver-fish, 18
Silver-spot skipper, 36
Siricidae, 53
Skippers, 28, 36
Skunk, 73
Slug Caterpillar, 36
Snakes, 64
Snapping-bugs, 48
Snapping Turtle, 67
Soricidae, 72
Sovereigns, 42
Sow-bugs, 15
Speckled Tortoise, 68
Sphecina, 51
Sphingidae, 53
Spiders, 17
Spirobolus, 17
Spittle Insects, 24
Sponges, 13
Spreading Adder, 66
Spring Azure, 44
Squirrels, 71
Stable-fly, 46
Stag-beetles, 48
Staphylinidae, 48

Stink Bugs, 27
 Stink-pot, 68
 Stone Cat, 56
 Stout Salamander, 61
 Straight-bodied Prionid, 49
 Striped Salamander, 61
 Suckers, 59
 Sunfishes, 59
 Swift, 67
 Syrphidae, 45

Tailed Blue, 44
 Talpidae, 72
 Tent Caterpillar, 36
 Testudinata, 64
 Thalessa, 54
 Thread-legged Bugs, 26
 Thread-waisted Wasps, 57
 Thysanura, 18
 Tiger Beetles, 47
 Tipulidae, 45
 Tiger Moths, 33
 Tiger Swallow-tail, 38
 Tineinas, 34
 Tingitidae, 26
 Toad, 62
 Tobacco-worm Moth, 33
 Tolyte, 36
 Tomato-worm Moth, 33
 Tortricina, 35
 Tree Crickets, 22
 Tree Hoppers, 24
 Tree Toad, 62
 Trout, 56
 True Cricket, 22
 Turtles, 67

Univalves, 14
 Urodella, 61

Variegated Fritillary, 40
 Vermes, 14
 Vertebrata, 55
 Vespa, 55
 Vespertilionidae, 72
 Vespidae, 52
 Vespina, 51
 Viceroy, 42
 Violet Tip, 42

Walking sticks, 23
 Walnut Caterpillar, 35
 Wanderer, 44
 Water-boatmen, 25
 Water-louse, 16
 Water-scarvenger Beetles, 47
 Water-scorpions, 25
 Water Snakes, 65
 Water Striders, 26
 Weasel, 74
 Whirligig Beetles, 47
 White-footed Mouse, 71
 White-lined Sphinx, 33
 Wild Cat, 74
 Wood Chuck, 71
 Wood Frog, 62
 Wood-lice, 15
 Wood Mouse, 71
 Wood Tortoise, 67
 Worms, 14

Yellow-bear, 34
 Yellow-jacket, 52
 Yellow-winged Locust, 21

Zebra-Swallow-tail, 39
 Zepodidae, 70





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